

# REGISTRATIONS OF CULTIVARS

## Registration of 'Hamria' Lentil

'Hamria' lentil (*Lens culinaris* Medik.) (Reg. no. CV-16, PI 633422) was developed at the International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria, and released by the National Institute for Agronomic Research (INRA), Settat, Morocco, for commercial cultivation. The cultivar was released in Morocco in 1999 for stable and higher yield and for combined resistance to rust [caused by *Uromyces viciae-fabae* (Pers.) Schroet] and Ascochyta blight (caused by *Ascochyta fabae* Speg. f. sp. *lentis* Gossen, Sheard, Beauchamp & Morrall). Because of its wide adaptation, Hamria is recommended for cultivation in all lentil-growing areas in the country.

The Food Legume Improvement Program of INRA, Settat, Morocco, introduced line ILL 6238 from ICARDA in 1989 as a part of the Lentil International Screening Nursery. ILL 6238 is a breeding line derived from a cross between ILL 4354 and ILL 922. The female parent, ILL 4354, is a landrace from Jordan, and the male parent, ILL 922, is a germplasm accession from Turkey. The line was developed following a bulk-pedigree method. Single plant selection was done in the F<sub>4</sub> on the basis of higher podding intensity, medium maturity, and nonlodging habit. It was entered in the international testing program as FLIP 87-48L and later designated in ICARDA's Lentil Germplasm Catalog as ILL 6238.

ILL 6238 was initially identified as a promising line in 1990 at Sidi El Aidi research station of INRA, a relatively dry site with an annual average rainfall of 300 mm. In 1991-1992, the line was tested in a replicated preliminary yield trial at Marchouch, a more favorable station with seasonal rainfall of about 400 mm. The line performed very well with respect to agronomic traits and produced >2 Mg ha<sup>-1</sup>. In 1993-1994, it was tested in advanced yield trials at two sites, Jemat Shaim (rainfall, 330 mm) and Marchouch (rainfall, 290 mm), and was found superior to other test entries including the check L 24. From 1995 to 1997, line ILL 6238 was evaluated at four sites, three of which are located in the plains (Sidi El Aidi, Jemat Shaim, Marchouch) and at Annoceur (rainfall, 450 mm), a high altitude site located in the mid-Atlas mountains.

Over the years and across locations, ILL 6238 produced an average yield of 1211 kg ha<sup>-1</sup> as compared with 1070 kg ha<sup>-1</sup> for the check, L 24, an increase of about 13% (Sakr, 2000). In farmers' field demonstrations during 1996-1997 and 1997-1998 cropping seasons, it produced an average yield of 910 kg ha<sup>-1</sup> as compared with 520 kg ha<sup>-1</sup> obtained from the local cultivars, an average increase of 75%. On the basis of the above results, ILL 6238 was tested under National Catalogue Trials for its eventual registration. Because of its good performance and farmers' preference, ILL 6238 was released in 1999 and was given the popular name Hamria.

Hamria is an erect and tall cultivar with an average height of 45 cm. It develops 2 to 3 primary branches per plant. The first pod-bearing node is about 16 cm above ground level, which allows machine harvest with minimum loss. Its leaves are light green with pubescence and comprised of 10 to 14 narrow leaflets. The stem is green and flowers are white. Plants bear an average of 35 pods, each of which contains one seed with beige testa color, but with bright red cotyledons. Pods of Hamria are nonpigmented and are borne two per peduncle.

Seeds are small and average with about 3 g 100<sup>-1</sup> seeds.

Hamria flowers in 90 d and matures in 130 d. Seed of Hamria is maintained at INRA, Settat, Morocco, and also at the Germplasm Program, ICARDA, Aleppo, Syria, and is available in small quantities on written request. Plant variety protection will not be sought for Hamria.

B. SAKR, A. SARKER,\* H. EL HASSAN, N. KADAH,  
B.A. KARIM, AND W. ERSKINE

## References

Sakr, B. 2000. Amélioration génétique des lentilles. Rapport de synthèse des travaux de recherche effectués par B. Sakr. INRA, Settat, Morocco.

B. Sakr, INRA, Settat, Morocco; A. Sarker, H. El Hassan, N. Kadah, B.A. Karim, and W. Erskine, International Center for Agricultural Research in the Dry Areas, Aleppo, Syria. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (A.Sarker@cgiar.org).

Published in Crop Sci. 44:686 (2004).

## Registration of 'Bichette' Lentil

'Bichette' lentil (*Lens culinaris* Medik.) (Reg. no. CV-17, PI 633421) was released in Morocco by the National Institute for Agronomic Research (INRA), Settat in 1999. Bichette is a medium large-seeded high-yielding lentil with wide adaptation, and hence is recommended for cultivation in all lentil-production areas in Morocco.

Bichette was introduced to Morocco in 1987 from the International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria, through the Food Legume International Nursery Program. It is a selection from a landrace originating from Jordan (76TA 66005) and has been registered in the Lentil Germplasm Catalog of the Genetic Resources Unit of ICARDA as ILL 5562.

Bichette (ILL 5562) was initially identified as a promising line at Sidi El Aidi, an INRA experimental station in the semi dry areas of Morocco, which receives an annual average rainfall of 300 mm. The line was subsequently tested in 1991 in a replicated preliminary yield trial conducted at Marchouch station (rainfall, 400 mm), where it showed a very high yield potential of 2840 kg ha<sup>-1</sup>. In 1993-1994 and 1994-1995, the line was evaluated in advanced yield trials at two sites; Jemat Shaim (rainfall, 330 mm) and Marchouch. The line again showed superiority in yield at both sites over a number of test entries, including the improved check, L 24.

From 1995-1996 to 1998-1999, Bichette was evaluated at four sites representing the major production zones of lentil in Morocco. Three of these sites (Sidi El Aidi, Jemat Shaim, and Marchouch) are located in the plains, while Annoceur (rainfall, 450 mm) is located in the mid-Atlas Mountains. Over this period and across four locations, ILL 5562 produced an average yield of 1321 kg ha<sup>-1</sup> compared with 955 kg ha<sup>-1</sup> for the check L 24, an increase of 38%. No significant genotype × environment interaction was observed, indicating that Bichette is widely adapted.

Good performance of Bichette has also been observed at farmers' fields. During 1996-1997 and 1997-1998 cropping seasons, two farmers located in the areas of Sidi El Aidi and Jemat Shaim conducted four on-farm demonstration trials. In those trials, Bichette produced twice the yield when compared

to the farmer's local cultivars (Sakr, 2000). The line was later evaluated under National Catalog Trials organized by the National Variety Release Committee. On the basis of its high performance in various stages of evaluation, ILL 5562 was released for commercial cultivation by Moroccan farmers with its popular name Bichette.

Bichette is a semierect and medium-statured cultivar averaging 40 cm tall and with 2 to 3 primary branches per plant. The height of the first pod-bearing node is 14 to 17 cm above ground level, which helps reduce harvest losses. Leaves are light green, slightly pubescent, and composed of up to 16 medium-sized leaflets, ending in small tendrils. Flower color is white. Bichette flowers in 110 d and matures in 150 d, which is more than 1 wk earlier than the check, L 24. Bichette bears an average of 45 pods per plant, which are nonpigmented and often grouped in 2 or 3 pods per peduncle. Seeds are round with yellow cotyledons and weigh about 4.5 g 100<sup>-1</sup> seeds. Pods do not shatter at maturity, a highly desirable trait for machine harvest. One of the important characteristics of Bichette is that it has a high level of tolerance to both rust [caused by *Uromyces viciae-fabae* (Pers.) Schroet. (Pucciniaceae, Uredinales)] and Ascochyta blight (caused by *Ascochyta fabae* Speg. f. sp. *lentis* Gossen, Sheard, Beauchamp & Morrall) diseases.

The seed of Bichette is maintained at INRA, Settat, Morocco, and at Germplasm Program, ICARDA, and is available in small quantities on written request. Plant variety protection will not be sought for Bichette.

B. SAKR, A. SARKER,\* H. EL HASSAN, N. KADAH,  
B.A. KARIM, AND W. ERSKINE

### References

- Sakr, B. 2000. Amélioration génétique des lentilles. Rapport de synthèse des travaux de recherche effectués par B. Sakr. INRA, Settat, Morocco.
- B. Sakr, Legume Breeder, INRA, Settat, Morocco; A. Sarker, H. El Hassan, N. Kadah, B.A. Karim and W. Erskine, International Center for Agricultural Research in the Dry Areas, Aleppo, Syria. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (A.Sarker@cgiar.org).
- Published in Crop Sci. 44:686–687 (2004).
- Registration of 'Ohio FG3' Soybean**
- 'Ohio FG3' soybean [*Glycine max* (L.) Merr.] (Reg. no. 454, PI 629008) was developed by the Ohio Agricultural Research and Development Center of The Ohio State University (OARDC-OSU). It was released for the food-type market on 1 August 2001 because of its high seed yield, large seed, early maturity, disease resistance, and high seed protein content.
- Ohio FG3 is an F<sub>4</sub>-derived line, originally designated HS96-3144, from the cross HS89-8843 × 'Ohio FG1' (St. Martin et al., 1996). The parentage of HS89-8843 is 'Hayes' × 'LS301' (McBlain et al., 1991; Fehr et al., 1990). The cross from which Ohio FG3 originated was made in the summer of 1992 at Columbus, OH, and subsequent development was by early generation testing (Cooper, 1990). The F<sub>2</sub>-derived line, HS94-8010, was tested in Ohio from 1994 to 1996. Ohio FG3, a selection from HS94-8010, was tested in multiple Ohio locations from 1997 to 2000.
- Ohio FG3 has indeterminate stem habit, purple flowers, gray pubescence, brown pods, dull yellow seed coats, and yellow hila. Ohio FG3 is in maturity group II (relative maturity 2.7), and is adapted as a full-season cultivar from 41 to 43° N lat. In Ohio tests (1998 to 2000, three or four locations per year) (St. Martin et al., 2001), seed yield of Ohio FG3 was 6% greater than that of 'Vinton 81' (Fehr et al., 1984) and 6% less than that of Ohio FG1 (St. Martin et al., 1996). Ohio FG3 matured 1 d later than Vinton 81. Ohio FG3 was similar to Ohio FG1 in height and lodging resistance. Seed protein content of Ohio FG3 was 14 g kg<sup>-1</sup> greater than that of Ohio FG1. Weight of 100 seeds of Ohio FG3 averaged 22.0 g, compared with 22.8 g for Ohio FG1.
- Hypocotyl inoculation with a series of isolates of *Phytophthora sojae* M. J. Kaufmann and J. W. Gerdemann demonstrated that Ohio FG3 carries the *Rps1k* and *Rps3* genes for race-specific resistance to *Phytophthora* root and stem rot.
- Breeder seed of Ohio FG3 was distributed to Ohio Foundation Seeds, Inc. for production of Foundation seed in 2001. Breeder seed will be maintained by OARDC-OSU with the cooperation of Ohio Foundation Seeds, Inc. A small sample of seed for research purposes can be obtained from the corresponding author. Recipients of seed are asked to acknowledge the source of germplasm if it is used in the development of new germplasm, cultivars, or genetic stocks. U.S. Plant Variety Protection for Ohio FG3 has been granted.
- S.K. ST. MARTIN,\* G.R. MILLS, R.J. FIORITTO,  
S.A. MCINTYRE, A.E. DORRANCE, AND R.L. COOPER
- References**
- Cooper, R.L. 1990. Modified early generation testing procedure for yield selection of soybean. Crop Sci. 30:417–419.
- Fehr, W.R., J.B. Bahrenfus, and A.K. Walker. 1984. Registration of Vinton 81 soybean. Crop Sci. 24:384.
- Fehr, W.R., S.R. Cianzio, and G.A. Welke. 1990. Registration of 'LS301' soybean. Crop Sci. 30:1363–1364.
- McBlain, B.A., R.J. Fioritto, S.K. St. Martin, A. Calip-DuBois, A.F. Schmitthenner, R.L. Cooper, and R.J. Martin. 1991. Registration of 'Hayes' soybean. Crop Sci. 31:488.
- St. Martin, S.K., A.J. Calip-DuBois, R.J. Fioritto, A.F. Schmitthenner, D.B. Min, T.-S. Yang, Y.M. Yu, R.L. Cooper, and R.J. Martin. 1996. Registration of 'Ohio FG1' soybean. Crop Sci. 36:813.
- St. Martin, S.K., R.L. Cooper, R.J. Fioritto, G.R. Mills, T. Mendiola, and S.A. McIntyre. 2001. Ohio performance trials of public soybean varieties. Horticulture and Crop Science Series 225. Ohio State Univ., Columbus, OH.
- S.K. St. Martin, G.R. Mills, R.J. Fioritto, and S.A. McIntyre, Dep. of Horticulture and Crop Science; A.E. Dorrance, Dep. of Plant Pathology; and R.L. Cooper, USDA-ARS and Dep. of Horticulture and Crop Science, Ohio Agric. Res. and Development Ctr., The Ohio State Univ., Columbus, OH 43210-1086. Research supported in part by gifts from the Ohio Seed Improvement Assoc. and grants from the Ohio Soybean Council. Salaries provided by state and federal funds appropriated to the Ohio Agric. Res. and Development Ctr., The Ohio State Univ. OARDC-OSU Manuscript no. HCS 01-5. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (stmartin+@osu.edu).
- Published in Crop Sci. 44:687 (2004).
- Registration of 'Soyola' Soybean**
- 'Soyola' soybean [*Glycine max* (L.) Merr.] (Reg. no. CV-462, PI 614702) was developed by USDA-ARS, in cooperation with the North Carolina Agricultural Research Service. It was released in 1999 to provide a high-yielding cultivar of Group VI maturity with a decreased concentration of linolenic acid in the seed lipids. Soyola is most adapted to production between 33 and 37° N latitude.
- Soyola is the bulk of an F<sub>5</sub>-derived line from the first backcross of a selection from the cross N87-2117-3 × 'Brim' to the cultivar Brim (Burton et al., 1994). The female parent, N78-2117-3 was a selection from the cross N78-2245 × PI 123440.

The line, N78-2245, has elevated levels of oleic acid in the seed oil and was derived from the fifth cycle population of a recurrent selection experiment (Burton et al., 1983). The parents of that population (RSFA) were PI 90406, PI 92567, and N69-2774, the *ms<sub>1</sub>* male-sterile germplasm line (Brim and Young, 1971). PI 123440 is a plant introduction with low linolenic acid relative to standard soybean cultivars.

Soyola was tested in the Uniform Preliminary VI nursery in 1995 (Kenty and Mosley, 1995) and in the Uniform VI nursery in 1996 and 1997 (Tyler and Bell, 1996, 1997). It was tested in the North Carolina Official Variety Trials in 1997 and 1998 (Bowman, 1997, 1998). In the Uniform tests (40 locations), Soyola matured on the same day as the check cultivar Brim in full-season planting. Averaged across all regional tests (1995–1997, 48 locations), the yield of Soyola was 3088 kg ha<sup>-1</sup>. Average yields of the check cultivars Brim and Dillon were 3085 kg ha<sup>-1</sup> and 3042 kg ha<sup>-1</sup>, respectively. In North Carolina Official variety trials (a total of 11 locations in 1997 and 1998), yields of Soyola were 4.7% higher than average yields of Dillon and Brim in the same tests.

In the 1995 Uniform VI nursery (five locations in NC, TX, AL, GA, and AR), linolenic acid concentration in the seed lipids of Soyola was 4.0 g 100<sup>-1</sup> g. In 1998 at one location in North Carolina, linolenic acid concentration of Soyola was 4.2 g 100<sup>-1</sup> g compared with 7.3 g 100<sup>-1</sup> g for the cultivar Dillon.

In the Uniform VI nurseries, plant height, seed quality, and lodging scores were similar for both Soyola and Brim. Soyola has yellow seed, with shiny luster, buff hila, white flowers, gray pubescence, brown pod walls, and determinate growth habit. Soyola has good resistance to lodging and *Soybean mosaic virus*. It is susceptible to stem canker [caused by *Diaporthe phaseolorum* (Cook and Ellis) Sacc. var. *meridionalis* F.A. Fernandez], root-knot nematodes [*Meloidogyne arenaria* (Neal Chitwood and *M. incognita* (Kofoid and White) Chitwood)], and soybean cyst nematodes (*Heterodera glycines* Schinohe).

In 1999, Breeder seed was provided to North Carolina Foundation Seed, Inc. Seed was distributed to other states by request and according to seed supply. The North Carolina Agricultural Research Service will be responsible for maintaining Breeder seed. Small samples (500 seeds) of Soyola can be obtained from the corresponding author for at least five years.

J.W. BURTON,\* R.F. WILSON, W. NOVITZKY,  
AND T.E. CARTER, JR.

## References

- Bowman, D.T. 1997. Measured crop performance soybean and cotton. Dep. of Crop Science, North Carolina State Univ., Raleigh, NC.
- Bowman, D.T. 1998. Measured crop performance soybean and cotton. Dep. of Crop Science, North Carolina State Univ., Raleigh, NC.
- Brim, C.A., and M.F. Young. 1971. Inheritance of a male-sterile character in soybeans. *Crop Sci.* 11:564–566.
- Burton, J.W., T.E. Carter, Jr., and E.B. Huie. 1994. Registration of 'Brim' soybean. *Crop Sci.* 34:301.
- Burton, J.W., R.F. Wilson, and C.A. Brim. 1983. Recurrent selection in soybeans IV. Selection for increased oleic acid percentage in seed oil. *Crop Sci.* 23:744–747.
- Kenty, M.M., and S.D. Mosley. (ed.) The uniform soybean tests, southern states: 1995. USDA-ARS, Stoneville, MS.
- Tyler, J.M., and P. Bell. (ed.) The uniform soybean tests, southern states: 1996. USDA-ARS, Stoneville, MS.
- Tyler, J.M., and P. Bell. (ed.) The uniform soybean tests, southern states: 1997. USDA-ARS, Stoneville, MS.

J.W. Burton, W. Novitzky and T.E. Carter, Jr., USDA-ARS, Dep. of Crop Science, N.C. State University, 3127 Ligon Street, Raleigh, NC 27607. R.F. Wilson, USDA-ARS-NPS-CPPVS, George Washington

Carver Center, 5602 Sunnyside Avenue, Beltsville, MD 20705-5139. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (jburton@croptserv1.crops.cnsu.edu).

Published in *Crop Sci.* 44:687–688 (2004).

## Registration of 'Horizon' Proso Millet

'Horizon' (Reg. no. CV-232, PI 633425) is a white proso millet (*Panicum miliaceum* L.) developed by the Nebraska Agricultural Experiment Station in cooperation with the University of Wyoming, South Dakota State University, Colorado State University, and the USDA-ARS Central Great Plains Research Station, Akron, CO, and tested as NE-9217. It was released jointly by the above cooperators in February 2003 for seed production.

Horizon traces to a single-plant F<sub>4</sub> selection made in 1992 from a bulk population that was developed in the greenhouse. The bulk population included 'Sunup' (Nelson, 1990), 'Rise' (Nelson, 1984), 'Dawn' (Nelson, 1976), 'Cope' (Hinze et al., 1978), and three lines that were later released as 'Earlybird' (Baltensperger et al., 1995a), 'Sunrise' (Baltensperger et al., 1997), and 'Huntsman' (Baltensperger et al., 1995b). The population was created by hot water emasculation of one-half the plants, and random pollination for two generations, followed by single-seed descent for three generations. Horizon has been tested in Nebraska yield nurseries starting in 1994 and in regional trials from 1998 to 2002.

Horizon has a white seed coat (lemma and palea) and a compactum (closed)-type panicle. The foliage is green in color and is similar to Sunup. In regional trials, mean grain yields of Horizon, Sunrise, Huntsman, and Earlybird were similar. Horizon has been broadly adapted across the High Plains region, yielding well from South Dakota to Colorado and Wyoming.

Horizon is similar in maturity to Sunrise and Earlybird, and later than Dawn. Dawn is generally ready for harvest at least 1 wk earlier than Horizon. Flowering is similar to Sunrise and Earlybird, but the seed fill period is shorter with appropriate moisture for harvest being reached 2 to 3 d earlier. Seed size of Horizon (158 seeds g<sup>-1</sup>) is similar to Sunrise, Earlybird, and Huntsman. Grain-volume weight of Horizon (725 g L<sup>-1</sup>) is similar to Earlybird (721 g L<sup>-1</sup>) and Sunrise (728 g L<sup>-1</sup>), and over the past 4 yr has generally been higher than other released cultivars. Horizon (84 cm) is similar in height to Earlybird, Sunrise, Sunup, and Huntsman (89 to 91 cm), but taller than Dawn (71 cm). The straw strength of Horizon is similar to Sunup. Less than 0.1% partially red seed coat is present in Horizon.

Horizon has shown no susceptibility to Russian wheat aphid [*Diuraphis noxia* (Mordvilko)]. Dawn and other lines have been attacked by head rot associated with stem boring insects such as stem maggot (*Meromyza* spp.) and European corn borer [*Ostrinia nubilalis* (Hübner)] in the same nurseries where Horizon has not shown symptoms. Horizon may have escaped because of preference based on relative maturity rather than resistance.

Breeder seed of Horizon will be maintained by the Nebraska Agricultural Experiment Station. Foundation seed can be obtained from the Nebraska Foundation Seed Division, Department of Agronomy and Horticulture, 3115 N. 70th, University of Nebraska-Lincoln, Lincoln, NE 68507-2104. Seed classes will be Breeder, Foundation, Registered, and Certified. Horizon will not be submitted for U.S. Plant Variety Protection but will be trademarked.

D.D. BALTENSPERGER,\* G.E. FRICKEL, L.A. NELSON,  
J.M. KRALL, M. VIGIL, J. HAIN, J. JOHNSON, C. STYMIEST,  
AND J.R. RICKERTSEN



## References

- Baltensperger, D.D., L.A. Nelson, and G.E. Frickel. 1995a. Registration of 'Earlybird' proso millet. *Crop Sci.* 35:1204–1205.
- Baltensperger, D.D., L.A. Nelson, G.E. Frickel, and R.L. Anderson. 1995b. Registration of 'Huntsman' proso millet. *Crop Sci.* 35:941.
- Baltensperger, D.D., L.A. Nelson, G.E. Frickel, and R.L. Anderson. 1997. Registration of 'Sunrise' proso millet. *Crop Sci.* 37:1380.
- Hinze, G., H.O. Mann, E.J. Langin, and A. Fisher. 1978. Registration of 'Cope' proso millet. *Crop Sci.* 18:1093–1094.
- Nelson, L.A. 1976. Registration of 'Dawn' proso millet. *Crop Sci.* 16:739.
- Nelson, L.A. 1984. Registration of 'Rise' proso millet. *Crop Sci.* 24:383.
- Nelson, L.A. 1990. Registration of 'Sunup' proso millet. *Crop Sci.* 30:746–747.

D.D. Baltensperger, G.E. Frickel, and L.A. Nelson, Dep. of Agronomy and Horticulture, Univ. of Nebraska, Lincoln, NE 68583; J.M. Krall, Dep. of Plant Sciences, Univ. of Wyoming, Laramie, WY 82071; M. Vigil, USDA-ARS, Central Great Plains Research Station, 40335 Co. Rd. GG, Akron, CO 80720; and J. Hain and J. Johnson, Dep. of Soil and Crop Sciences, Colorado State University, Fort Collins, CO 80523; C. Szymist and J.R. Rickertsen, Dep. of Agronomy, South Dakota State University, Brookings, SD 57007. Contribution No. 14026 from the Nebraska Agric. Res. Div. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (dbaltensperger1@unl.edu).

Published in *Crop Sci.* 44:688–689 (2004).

## Registration of 'Desha' Soybean

'Desha' soybean [*Glycine max* (L.) Merr.] (Reg. no. CV-455, PI 633610) was developed by the Arkansas Agricultural Experiment Station and released as a Maturity Group VI cultivar with high yield potential, good standability, shattering resistance, and resistance to stem canker [caused by *Diaporthe phaseolorum* (Cooke & Ellis) Sacc. f. sp. *meridionalis* Morgan-Jones] and *Soybean mosaic virus*.

Desha originated from an individual F<sub>4</sub> plant selection from the cross 'Hutcheson' × 'Walters' (Buss et al., 1988; Caviness et al., 1991). The F<sub>2</sub> and subsequent generations were advanced by the single pod bulk method (Fehr, 1991) in Fayetteville, AR. The F<sub>4.5</sub> line, designated R92-1258, was selected at Stuttgart, AR, in 1992 and seeds were bulked for subsequent yield trials. Desha was tested as experimental line R92-1258 in a total of 51 environments for disease resistance, agronomic performance, and seed yield in the Arkansas soybean breeding program from 1993 to 2001 where it exceeded the seed yield of the check cultivar Dillon (Shipe et al., 1997) by 5.0%. Desha was also evaluated in the Arkansas state variety testing program in 28 environments from 1997 to 2002 where it averaged 7.8% higher in seed yield than Dillon (Dombek et al., 1997, 1998, 1999, 2000, 2001, 2002). In addition, it was evaluated in USDA Southern Regional Preliminary Group VI Test in 1995 and in USDA Southern Regional Uniform Group VI Test from 1996 to 1998 where it averaged 2.5% higher in seed yield than Dillon (Tyler, 1995, 1996, 1997, 1998). In a total of 135 full-season tests in southern states, the average seed yield of Desha was about 4.5% higher than that of Dillon. It is widely adapted to the areas between 33 and 37° N latitude, but appears to be best adapted to the Arkansas and Mississippi delta region.

Desha is an early-Maturity Group VI determinate cultivar that has similar maturity date and plant height to Dillon. It has white flowers, gray pubescence, and tan pod walls. Seeds of Desha have yellow cotyledons with dull yellow seed coats and buff hila, and average about 0.5 mg heavier than seeds of Dillon. Lodging, shattering, and average seed quality scores are similar to those of Dillon. Seed protein content is slightly

(5–10 g kg<sup>-1</sup>) lower and oil content slightly (5–10 g kg<sup>-1</sup>) higher than Dillon.

Desha is resistant to southern stem canker and soybean mosaic virus. It is susceptible to soybean cyst nematode (*Heterodera glycines* Ichinohe), *Phytophthora* root rot [caused by *Phytophthora sojae* (Kaufmann & Gerdemann)], reniform nematode [*Rotylenchulus reniformis* (Linford & Oliveira)], root knot nematode [*Meloidogyne arenaria* (Neal) Chitwood and *Meloidogyne incognita* (Kofoid & White) Chitwood], and sudden death syndrome [caused by *Fusarium solani* (App. & Wollenw.) f. sp. *glycines*].

Foundation seed will be produced and distributed by the Arkansas Foundation Seed Program, Rice Research and Extension Center, 2900 Highway 130 East, Stuttgart, AR 72160. The Arkansas Agricultural Experiment Station will be responsible for maintenance of Breeder seed. Small quantities of Desha seeds can be obtained for breeding and research purposes from the corresponding author for at least 5 yr from the date of this publication.

C.H. SNELLER, P. CHEN,\* J.C. RUPE, AND R.D. RIGGS

## References

- Buss, G.R., H.M. Camper, Jr., and C.W. Roane. 1988. Registration of 'Hutcheson' soybean. *Crop Sci.* 28:1024–1025.
- Caviness, C.E., R.D. Riggs, and J.C. Rupe. 1991. Registration of 'Walters' soybean. *Crop Sci.* 31:850.
- Dombek, D.G., D.K. Ahrent, and R.D. Bond. 1997. Arkansas Soybean Performance tests 1997. Variety Testing Publication 2088, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, and R.D. Bond. 1998. Arkansas Soybean Performance tests 1998. Variety Testing Publication 2098, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, R.D. Bond, and I.L. Eldridge. 1999. Arkansas Soybean Performance tests 1999. Variety Testing Publication 2109, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, R.D. Bond, and I.L. Eldridge. 2000. Arkansas Soybean Performance tests 2000. Variety Testing Publication 2110, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, R.D. Bond, and I.L. Eldridge. 2001. Arkansas Soybean Performance tests 2001. Research Series 489, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, R.D. Bond, and I.L. Eldridge. 2002. Arkansas Soybean Performance tests 2002. Research Series 500, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Fehr, W.R. 1991. Principles of cultivar development. Volume 1. Theory and technique. Iowa State Univ. Press, Ames.
- Shipe, E.R., J.D. Mueller, S.A. Lewis, P.F. Williams, Jr., and J.P. Tomkins. 1997. Registration of 'Dillon' soybean. *Crop Sci.* 37:1983.
- Tyler, J.M. (ed.) 1995. The uniform soybean tests, southern states. USDA-ARS, Stoneville, MS.
- Tyler, J.M. (ed.) 1996. The uniform soybean tests, southern states. USDA-ARS, Stoneville, MS.
- Tyler, J.M. (ed.) 1997. The uniform soybean tests, southern states. USDA-ARS, Stoneville, MS.
- Tyler, J.M. (ed.) 1998. The uniform soybean tests, southern states. USDA-ARS, Stoneville, MS.

C.H. Sneller, Dep. of Horticulture and Crop Science, The Ohio State Univ., Wooster, OH, 44691; P. Chen, Dep. of Crop, Soil, and Environmental Science, J.C. Rupe and R.D. Riggs, Dep. of Plant Pathology, Univ. of Arkansas, Fayetteville, AR 72701. Contribution from the Arkansas Agric. Exp. Stn. The research was supported in part by a grant from the Arkansas Soybean Promotion Board. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (pchen@uark.edu).

Published in *Crop Sci.* 44:689 (2004).

## Registration of 'Lonoke' Soybean

'Lonoke' soybean [*Glycine max* (L.) Merr.] (Reg. no. CV-461, PI 633609) was developed by the Arkansas Agricultural

Experiment Station. It was released because of its high yield potential, good standability, shattering resistance, and resistance to several important diseases in the mid-south.

Lonoke was selected as an  $F_4$  plant from a population derived from the cross 'Manokin' (Kenworthy, 1996)  $\times$  Asgrow 'A6297'. The parents of A6297 were 'Young' and A5474. A5474 was derived from the cross J74-122  $\times$  ('Tracy'  $\times$  D71-6234). J74-122 was derived from the cross 'Forrest' (2)  $\times$  (D68-18  $\times$  PI 88788). D68-18 was a selection from the cross 'Dyer'  $\times$  'Bragg'. The parents of D71-6234 were D66-7398 and PI 95960. D66-7398 was derived from the cross D61-3505  $\times$  (PI 96035  $\times$  D61-2624). D61-3505 and D61-2624 were sister lines derived from the backcross D49-2491 (4)  $\times$  PI 163453. D49-2491 was a breeding line selected from the cross S100  $\times$  CNS. The cross Manokin  $\times$  A6297 was made and the derived plant population was advanced to the  $F_4$  generation by the single pod bulk method (Brim, 1966) in Fayetteville, AR. The  $F_{4.5}$  line, designated R95-2210, was selected at Keiser, AR, in 1995 and seeds were bulked for subsequent yield trials.

Lonoke was tested as experimental line R95-2210 for disease resistance, agronomic performance, and seed yield in the Arkansas cultivar testing program from 1996 to 2001 where it exceeded the seed yield of the check cultivar Hutcheson (Buss et al., 1988) by 7.2% (Dombek et al., 1996, 1997, 1998, 1999, 2000, 2001). It was evaluated in USDA Southern Regional Preliminary Group V Test in 1998 and in USDA Southern Regional Uniform Group V Test from 1999 to 2001 where it averaged 2% higher in seed yield than Hutcheson (Tyler, 1998, 1999; Paris, 2000, 2001). In 79 full-season tests in the southern states, the average seed yield of Lonoke was about 3 and 6% greater than that of Hutcheson and Manokin, respectively. It is widely adapted to the areas between 33 and 37° N latitude.

Lonoke is a late-Maturity Group V determinate cultivar that matures 2 to 4 d later than Hutcheson (Tyler, 1998, 1999; Paris, 2000, 2001). It has white flowers, gray pubescence, and tan pod walls. Mature plants of Lonoke average 10 cm taller than Hutcheson. Seed of Lonoke have yellow cotyledons with dull yellow seed coats and buff hila, and average about 1 mg smaller than seed of Hutcheson. Lodging, shattering, and average seed quality scores are similar to those of Hutcheson. Seed protein content is slightly (5–10 g kg<sup>-1</sup>) higher and oil content slightly (5–10 g kg<sup>-1</sup>) lower than that of Hutcheson.

Lonoke is resistant to southern stem canker [caused by *Diaporthe phaseolorum* (Cooke & Ellis) Sacc. f. sp. *meridionalis* Morgan-Jones] and soybean cyst nematode (*Heterodera glycines* Ichinohe) races 3 and 14. Lonoke is moderately resistant to Phytophthora rot [caused by *Phytophthora sojae* (Kaufmann & Gerdemann)], races 5 and 9 of soybean cyst nematode, reniform nematode [*Rotylenchulus reniformis* (Linford & Oliveira)], sudden death syndrome [caused by *Fusarium solani* (App. & Wollenw.) f. sp. *glycines*], and frogeye leaf spot (caused by *Cercospora sojae* Hara). Lonoke is susceptible to root knot nematode [*Meloidogyne arenaria* (Neal) Chitwood and *Meloidogyne incognita* (Kofoid & White) Chitwood] and Soybean mosaic virus.

Foundation seed will be produced and distributed by the Arkansas Foundation Seed Program, Rice Research and Extension Center, 2900 Highway 130 East, Stuttgart, AR 72160. The Arkansas Agricultural Experiment Station will be responsible for maintenance of Breeder seed. Small quantities of Lonoke seeds can be obtained for breeding and research purposes from the corresponding author for at least 5 yr from the date of this publication.

C.H. SNELLER, P. CHEN,\* J.C. RUPE, AND R.D. RIGGS

## References

- Brim, C.A. 1966. A modified pedigree method of selection in soybean. *Crop Sci.* 6:220.
- Buss, G.R., H.M. Camper, Jr., and C.W. Roane. 1988. Registration of 'Hutcheson' soybean. *Crop Sci.* 28:1024–1025.
- Dombek, D.G., D.K. Ahrent, and R.D. Bond. 1996. Arkansas Soybean Performance tests 1996. Variety Testing Publication 2077, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, and R.D. Bond. 1997. Arkansas Soybean Performance tests 1997. Variety Testing Publication 2088, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, and R.D. Bond. 1998. Arkansas Soybean Performance tests 1998. Variety Testing Publication 2098, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, R.D. Bond, and I.L. Eldridge. 1999. Arkansas Soybean Performance tests 1999. Variety Testing Publication 2109, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, R.D. Bond, and I.L. Eldridge. 2000. Arkansas Soybean Performance tests 2000. Variety Testing Publication 2110, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Dombek, D.G., D.K. Ahrent, R.D. Bond, and I.L. Eldridge. 2001. Arkansas Soybean Performance tests 2001. Research Series 489, Arkansas Agric. Exp. Stn., Univ. of Arkansas.
- Kenworthy, W.J. 1996. Registration of 'Manokin' soybean. *Crop Sci.* 36:1079.
- Paris, R.L. (ed.) 2000. The uniform soybean tests, southern states. USDA-ARS, Stoneville, MS.
- Paris, R.L. (ed.) 2001. The uniform soybean tests, southern states. USDA-ARS, Stoneville, MS.
- Tyler, J.M. (ed.) 1998. The uniform soybean tests, southern states. USDA-ARS, Stoneville, MS.
- Tyler, J.M. (ed.) 1999. The uniform soybean tests, southern states. USDA-ARS, Stoneville, MS.

C.H. Sneller, Dep. of Horticulture and Crop Science, The Ohio State Univ., Wooster, OH, 44691; P. Chen, Dep. of Crop, Soil, and Environmental Science; J. C. Rupe and R.D. Riggs, Dep. of Plant Pathology, Univ. of Arkansas, Fayetteville, AR 72701. Contribution from the Arkansas Agric. Exp. Stn. The research was supported in part by a grant from the Arkansas Soybean Promotion Board. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (pchen@uark.edu).

Published in *Crop Sci.* 44:689–690 (2004).

## Registration of 'Bolivar' Soybean

'Bolivar' soybean [*Glycine max* (L.) Merr.] (Reg. no. CV-456, PI 612146) was developed by the ARS-USDA and the Mississippi Agricultural and Forestry Experiment Station. It was released in June 1999 because it maintains adequate plant height in early season plantings on clayey soils, an environment that suppresses growth. It is a maturity group V cultivar which has shown high seed yield and adaptation to the high clay content soils of the lower Mississippi River valley and east Mississippi.

Bolivar was developed by the USDA-ARS soybean breeding program at Stoneville, MS. Bolivar was derived from an  $F_4$  plant selection from the cross 'A5979'  $\times$  'DP3589'. This population was advanced from the  $F_2$  to the  $F_4$  generations by single seed descent (Brim, 1966). A5979 was selected from the cross 'Young' (Burton et al., 1987)  $\times$  'A5474' (Shannon and Schillinger, 1989). DP 3589 is a sib of 'DP3588' (Shannon and Collins, 2001). Bolivar was tested as DT95-15091 and was originally segregating for pubescence color. In October 1997, 100 tawny  $F_7$  plants were individually harvested, and  $F_{7.8}$  lines were grown in a winter nursery. Seeds from 78 uniformly tawny rows were bulk-harvested and used for all 1998 and subsequent trials.

Bolivar was evaluated in breeder plots in five environments in 1997, four in Mississippi and one in Tennessee. It yielded

423 kg ha<sup>-1</sup> more than the 'DP3588'. In 1998, Bolivar was evaluated in 22 environments: breeder plots (5), Uniform Preliminary Group V (9), Mississippi state variety trials (6), and Arkansas state variety trials (2). Averaged across these environments, Bolivar yielded 336 kg ha<sup>-1</sup> more than 'Hutcheson' (Buss et al., 1988). Bolivar averaged 275 kg ha<sup>-1</sup> more than Hutcheson over 4 yr of testing in Mississippi state variety trials (1998 to 2001) (White et al., 2001). In these tests, Bolivar averaged 29 cm taller in height and 1 d later in maturity than Hutcheson.

Bolivar has purple flowers, tawny pubescence, tan pods at maturity, and dull yellow seeds with black hila. Seed protein and oil for Bolivar were 425 g kg<sup>-1</sup> and 197 g kg<sup>-1</sup> compared with 410 and 211 g kg<sup>-1</sup> for Hutcheson in the 1998 USDA Uniform tests (Tyler and Bell, 1998).

Bolivar segregates for reaction to southern stem canker [caused by *Diaporthe phaseolorum* (Cooke & Ellis) Sacc. var. *meridionalis* F. A. Fernandez]. It is resistant to Race 3 of the soybean cyst nematode, *Heterodera glycines* Ichinohe.

Breeder seed will be maintained by USDA-ARS. U.S. Plant Variety Protection of Bolivar is pending (PVP certificate no. 200000051). Small amounts of seed may be obtained from the Crop Genetics & Production Research Unit, P. O. Box 345, Stoneville, MS 38776-0345.

J.M. TYLER AND L.D. YOUNG\*

### References

- Brim, C.A. 1966. A modified pedigree method of selection in soybeans. *Crop Sci.* 6:220.  
 Burton, J.W., C.A. Brim, and M.F. Young. 1987. Registration of 'Young' soybean. *Crop Sci.* 27:1093.  
 Buss, G.R., H.M. Camper, Jr., and C.W. Roane. 1988. Registration of 'Hutcheson' soybean. *Crop Sci.* 28:1024-1025.  
 Shannon, J.G., and H.B. Collins. 2001. Registration of 'DP3588' soybean. *Crop Sci.* 41:592-593.  
 Shannon, J.G., and J.A. Schillinger. 1989. Registration of 'A5474' soybean. *Crop Sci.* 29:1091.  
 Tyler, J.M., and P.A. Bell. 1998. Uniform soybean tests southern states: 1998. USDA-ARS, Stoneville, MS.  
 White, B., A. Blaine, D. Ingram, R. Ivy, W. Marlow, A. Smith, C. Watson, M. Young, and L. Zhang. 2001. Mississippi soybean variety trials 2001. Mississippi State University, Mississippi State, MS.

J.M. Tyler, Delta and Pine Land Company, P. O. Box 157, Scott, MS 38772; L.D. Young, USDA ARS, P.O. Box 345, Stoneville, MS 38776-0345. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (ldyoung@ars.usda.gov).

Published in *Crop Sci.* 44:690-691 (2004).

### Registration of 'Dilworth' Soybean

'Dilworth' soybean [*Glycine max* (L.) Merr.] (Reg. no. CV-457, PI 633608) was developed by the Ohio Agricultural Research and Development Center of The Ohio State University (OARDC-OSU). It was released 1 Aug. 2002 because of its high yield potential and resistance to Phytophthora rot (caused by *Phytophthora sojae* Kaufmann and Gerdemann).

Dilworth, originally designated HF98-023, is an F<sub>4</sub>-derived line, from the cross 'Chapman' (McBlain et al., 1991) × 'Probst' (Wilcox and Abney, 1995) made during the summer of 1993 at Wooster, OH. Dilworth was developed by early generation testing. It was tested as an F<sub>2</sub>-derived experimental line (OX93329-7) in Ohio in 1995 and 1996. As an F<sub>4</sub> plant selection from OX93329-7, Dilworth was tested at 15 Ohio locations from 1999 through 2001 (St. Martin et al., 2002). HF98-023 was evaluated regionally in the USDA Northern Uniform Soybean Preliminary Test IIIB in 2000 and in the USDA Northern Uniform Soybean Test III in 2001 (Nowling, 2001, 2002).

Dilworth has indeterminate stem habit, purple flowers, tawny pubescence, brown pods, and dull yellow seed coats with black hila. Dilworth is a Maturity Group III (relative maturity 3.1) cultivar, generally adapted as a full-season cultivar from 40 to 42° N. latitude. In Ohio tests from 1999 to 2001, seed yield of Dilworth was 4% greater than 'Defiance' (St. Martin et al., 1997), a high yielding Ohio variety. Dilworth was similar to Defiance in mature plant height (81 vs. 79 cm). Both lines had a lodging score of 1.5 on a 1-to-5 scale, where 1 is erect and 5 is prostrate. Relative maturity for Dilworth was 3.1 while Defiance matured one and a half days later on average and had a relative maturity of 3.3. Seed protein and oil contents for Dilworth and Defiance were 409 g kg<sup>-1</sup> and 210 g kg<sup>-1</sup> and 418 g kg<sup>-1</sup> protein and 207 g kg<sup>-1</sup>, respectively. The 100-seed weight of Dilworth was 14.4 g.

Dilworth carries the *Rps1-k* and *Rps3-a* genes for race-specific resistance to Phytophthora rot. Dilworth is moderately susceptible to brown stem rot [caused by *Phialophora gregata* (Allington and Chamberlain) W. Gams].

Dilworth is named in honor of Alvin Dilworth. Mr. Dilworth was an OARDC farm manager who inspired fellow OARDC workers from July 1958 to April 1976; he passed away in 1983.

Breeder seed of Dilworth was distributed to Ohio Foundation Seeds, Inc. for production of Foundation seed in 2002. Breeder seed of Dilworth will be maintained with the cooperation of Ohio Foundation Seeds, Inc. by The Ohio State University, Ohio Agricultural Research and Development Center, 1680 Madison Avenue, Wooster, Ohio 44691-4096. A small sample of seed for research purposes can be obtained from the corresponding author.

R.J. FIORITTO,\* S.K. ST. MARTIN, A.E. DORRANCE,  
AND R.L. COOPER

### References

- McBlain, B.A., R.J. Fioritto, S.K. St. Martin, A. Calip-DuBois, A.F. Schmitthenner, R.L. Cooper, and R.J. Martin. 1991. Registration of 'Chapman' soybean. *Crop Sci.* 31:487.  
 Nowling, G.L. 2001. Uniform Soybean Tests-Northern Region 2000. USDA-ARS, West Lafayette, IN.  
 Nowling, G.L. 2002. Uniform Soybean Tests-Northern Region 2001. USDA-ARS, West Lafayette, IN.  
 St. Martin, S.K., A.J. Calip-DuBois, R.J. Fioritto, A.F. Schmitthenner, R.L. Cooper, and R.J. Martin. 1997. Registration of 'Defiance' soybean. *Crop Sci.* 37:1981.  
 St. Martin, S.K., R.L. Cooper, R.J. Fioritto, G.R. Mills, T. Mendiola, and S.A. McIntyre. 2002. Ohio performance trials of public soybean varieties. Horticulture and Crop Science Series 225. Ohio State Univ.  
 Wilcox, J.R., and T.S. Abney. 1995. Registration of 'Probst' Soybean. *Crop Sci.* 35:1713.

R.J. Fioritto, S.K. St. Martin, Dep. of Horticulture and Crop Science; A.E. Dorrance, Dep. of Plant Pathology; and R.L. Cooper, USDA-ARS and Dep. of Horticulture and Crop Science, Ohio Agric. Res. and Development Ctr., The Ohio State Univ., Columbus, OH 43210. Research supported in part by gifts from the Soybean Council. Salaries provided by state and federal funds appropriated to the Ohio Agric. Res. and Development Ctr., The Ohio State Univ. (OARDC-OSU Manuscript no.). Registration by CSSA. Accepted 31 July 2003 \*Corresponding author (fioritto.1@osu.edu).

Published in *Crop Sci.* 44:691 (2004).

### Registration of 'MN0201' Soybean

'MN0201' soybean [*Glycine max* (L.) Merr.] (Reg. no. CV-458, PI 629004) was developed by the Minnesota Agricultural Ex-



periment Station. It was released because of its high yield, yellow hilum and higher protein compared to other public cultivars of similar maturity.

MN0201 was derived from an F<sub>4</sub> plant selected from the cross 'Ozzie' × OT88-11 (Orf et al., 1985). OT88-11 is a selection from the cross 'Maple Ridge' × 'Lakota' (Bahrenfus and Fehr, 1984; Bernard et al., 1988). The population was advanced, without selection, via modified single seed descent (advancing a single multiseeded pod rather than a single seed per plant) to the F<sub>4</sub> generation in Chile and Minnesota. MN0201 was tested for yield in Minnesota from 1994 through 2000 (in 22 environments) under the designation M90-135046. It was evaluated in Uniform Test 0 from 1997 through 2000 of the Uniform Soybean Tests, Northern Region (Nowling, 2000).

MN0201 is classified as an early Group 0 maturity (relative maturity 0.2) averaging about 3 d later than 'Traill' (Helms and Nelson, 1998). It is best adapted as a full season cultivar to latitudes 45 to 47° N. It has indeterminate growth habit, purple flowers, tawny pubescence and brown pods at maturity. Seeds are yellow with yellow hila and dull seed coat luster. In comparison with Traill (mean yield 2694 kg ha<sup>-1</sup>), MN0201 had a yield advantage of about 5% in Uniform Soybean Tests (35 environments) and in Minnesota (22 environments) (Nowling, 2000). MN0201 is similar in lodging to Traill (score 1.6, on a 1-to-5 scale where 1 is no lodging and 5 is severe lodging) and is about 10 cm taller (Traill was 69 cm). Seeds of MN0201 are 17 mg seed<sup>-1</sup> lighter, about 11 g kg<sup>-1</sup> higher in protein and about 2 g kg<sup>-1</sup> higher in oil than seeds of Traill (167 mg, 419 g kg<sup>-1</sup>, and 197 g kg<sup>-1</sup>, respectively). MN0201 is similar in seed quality to Traill. The iron deficiency chlorosis scores of MN0201 and Traill (score 2.4 on a 1-to-5 scale where 1 is green and 5 is severe chlorosis) are similar; both being very good. MN0201 has the *Rps1a* gene for resistance to Phytophthora root rot (caused by *Phytophthora sojae* Kaufmann & Gerdemann).

MN0201 was released on 20 Jan 2001 to approved seed growers in Minnesota. Breeder seed of MN0201 will be maintained by the Minnesota Agricultural Experiment Station. Plant Variety Protection for MN0201 has been obtained (PVP 200200085). Small samples of MN0201 for research purposes can be obtained from the Minnesota Agricultural Experiment Station for at least 5 yr by writing to the corresponding author.

J.H. ORF\* AND R.L. DENNY

## References

- Bahrenfus, J.B., and W.R. Fehr. 1984. Registration of Lakota soybean. *Crop Sci.* 24:384–385.
- Bernard, R.L., G.A. Juvick, E.E. Hartwig, and C.J. Edwards, Jr. 1988. Origins and pedigrees of public soybean varieties in the United States and Canada. USDA-ARS Tech. Bull. 1746.
- Helms, T.C., and B.D. Nelson. 1998. Registration of 'Traill' soybean. *Crop Sci.* 38:549.
- Nowling, G.L. 2000. The uniform soybean tests, northern region. 2000. USDA-ARS, West Lafayette, IN.
- Orf, J.H., J.W. Lambert, and B.W. Kennedy. 1985. Registration of 'Ozzie' soybean. *Crop Sci.* 25:366.

J.H. Orf, Dep. of Agronomy and Plant Genetics, R.L. Denny, Dep. of Plant Pathology, University of Minnesota, St. Paul, MN 55108. Work supported in part by grants from the Minnesota Soybean Research and Promotion Council. Contribution from the Minnesota Agric. Exp. Stn. Registration by CSSA. Accepted 31 July 2003 \*Corresponding author. (orffx001@umn.edu)

## Registration of 'MN0302' Soybean

'MN0302' soybean [*Glycine max* (L.) Merr.] (Reg. no. CV-459, PI 629005) was developed by the Minnesota Agricultural Experiment Station. It was released because of its high yield, excellent iron deficiency chlorosis rating, and the *Rps1-k* gene for Phytophthora (caused by *Phytophthora sojae* Kaufmann & Gerdemann) resistance.

MN0302 was derived from an F<sub>4</sub> plant selected from the cross M84-93 × 'Maple Donovan' (Bernard et al., 1988). M84-93 is a selection from the cross M71-148 × 'Ozzie' (Orf et al., 1985). M71-148 is a selection from the cross 'Clay' × 'Evans' (Lambert, 1969; Lambert and Kennedy, 1975). The population was advanced, without selection, via modified single seed descent (advancing a single multiseeded pod rather than a single seed per plant) to the F<sub>4</sub> generation in Chile and Minnesota. MN0302 was tested for yield in Minnesota from 1994 through 2000 (in 25 environments) under the designation M90-217007. It was evaluated in Uniform Test 0 from 1997 through 2000 of the Uniform Soybean Tests, Northern Region (Nowling, 2000).

MN0302 is classified as an early Group 0 maturity (relative maturity 0.3) averaging about 4 d later than 'Traill' (Helms and Nelson, 1998). It is best adapted as a full season cultivar to latitudes 45 to 47° N. It has indeterminate growth habit, purple flowers, gray pubescence, and tan pods at maturity. Seeds are yellow with buff hila and dull seed coat luster. In comparison with Traill (mean yield 2694 kg ha<sup>-1</sup>), MN0302 had a yield advantage of about 10% in Uniform Soybean Tests (35 environments) and in Minnesota Tests (25 environments) (Nowling, 2000). MN0302 is slightly less susceptible to lodging than Traill (1.2 vs. 1.6 on a 1-to-5 scale where 1 is no lodging and 5 is severe lodging) and is about 8 cm taller (Traill was 69 cm). Seeds of MN0302 are 12 mg seed<sup>-1</sup> lighter, about 14 g kg<sup>-1</sup> lower in protein and about 11 g kg<sup>-1</sup> higher in oil than seeds of Traill (167 mg, 419 g kg<sup>-1</sup>, and 197 g kg<sup>-1</sup>, respectively). MN0302 is similar in seed quality to Traill. The iron deficiency chlorosis scores of MN0302 and Traill (score 2.4 on a 1-to-5 scale where 1 is green and 5 is severe chlorosis) are similar; both being very good.

MN0302 was released on 20 Jan. 2001 to approved seed growers in Minnesota. Breeder seed of MN0302 will be maintained by the Minnesota Agricultural Experiment Station. Plant Variety Protection for MN0302 has been obtained (PVP 200200086). Small samples of MN0302 for research purposes can be obtained from the Minnesota Agricultural Experiment Station for at least 5 yr by writing to the corresponding author.

J.H. ORF\* AND R.L. DENNY

## References

- Bernard, R.L., G.A. Juvick, E.E. Hartwig, and C.J. Edwards, Jr. 1988. Origins and pedigrees of public soybean varieties in the United States and Canada. USDA-ARS Tech. Bull. 1746.
- Helms, T.C., and B.D. Nelson. 1998. Registration of 'Traill' soybean. *Crop Sci.* 38:549.
- Lambert, J.W. 1969. Registration of 'Clay' soybean. *Crop Sci.* 9:525.
- Lambert, J.W., and B.W. Kennedy. 1975. Registration of 'Evans' and 'Hodgson' soybeans. *Crop Sci.* 15:735.
- Orf, J.H., J.W. Lambert, and B.W. Kennedy. 1985. Registration of 'Ozzie' soybean. *Crop Sci.* 25:366.
- Nowling, G.L. 2000. The uniform soybean tests, northern region. 2000. USDA-ARS, West Lafayette, IN.

J.H. Orf, Dep. of Agronomy and Plant Genetics, R.L. Denny, Dep. of Plant Pathology, University of Minnesota, St. Paul, MN 55108. Work supported in part by grants from the Minnesota Soybean Res. and Promotion Council. Contribution from the Minnesota Agric. Exp.

Stn. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author. (orffx001@umn.edu)

Published in Crop Sci. 44:692–693 (2004).

### Registration of 'MN1302' Soybean

'MN1302' soybean [*Glycine max* (L.) Merr.] (Reg. no. CV-460, PI 616498) was developed by the Minnesota Agricultural Experiment Station. It was released because of its high yield and *Rps1-k* gene for resistance to Phytophthora (caused by *Phytophthora sojae* Kaufmann & Gerdemann).

MN1302 was derived from an F<sub>4</sub> plant selected from the cross 'Hendricks' × 'Archer' (Cianzio et al., 1991; Orf et al., 1995). The population was advanced, without selection, via modified single seed descent (advancing a single multiseeded pod rather than a single seed per plant) to the F<sub>4</sub> generation in Chile and Minnesota. MN1302 was tested for yield in Minnesota from 1996 through 2000 (in 21 environments) under the designation M92-106016. It was evaluated in Preliminary Test I in 1998 and in the Uniform Test I in 1999 and 2000 of the Uniform Soybean Tests, Northern Region (Nowling, 2000).

MN1302 is classified as an early Group I maturity (relative maturity 1.3) averaging about 3 d earlier than 'Parker' (Orf and Kennedy, 1994). It is best adapted as a full season cultivar to latitudes 43 to 45° N. It has indeterminate growth habit, purple flowers, gray pubescence, and brown pods at maturity. Seeds are yellow with buff hila and dull seed coat luster. In comparison with Parker (mean yield 3312 kg ha<sup>-1</sup>), MN1302 had a yield advantage of about 2% in Uniform Soybean Tests (56 environments) and in Minnesota (21 environments) (Nowling, 2000). MN1302 is less susceptible to lodging than Parker (1.7 vs. 2.3 on a 1-to-5 scale where 1 is no lodging and 5 is severe lodging) and is about 8 cm shorter (Parker is 94 cm). Seeds of MN1302 are 6 mg seed<sup>-1</sup> heavier, about 10 g kg<sup>-1</sup> lower in protein and about 2 g kg<sup>-1</sup> higher in oil than seeds of Parker (174 mg, 411 g kg<sup>-1</sup>, and 201 g kg<sup>-1</sup>, respectively). MN1302 is similar in seed quality to Parker. The iron deficiency chlorosis scores of MN1302 and Parker (score 4.0 on a 1-to-5 scale where 1 is green and 5 is severe chlorosis) are similar, both being below average.

MN1302 was released on 15 Mar 2002 to approved seed growers in Minnesota. Breeder seed of MN1302 will be maintained by the Minnesota Agricultural Experiment Station. Small samples of MN1302 for research purposes can be obtained from the Minnesota Agricultural Experiment Station for at least 5 yr by writing to the corresponding author.

J.H. ORF\* AND R.L. DENNY

### References

- Cianzio, S.R., S.P. Schultz, W.R. Fehr, and H. Tachibana. 1991. Registration of 'Archer' soybean. Crop Sci. 31:1707.  
Orf, J.H., and B.W. Kennedy. 1994. Registration of 'Parker' soybean. Crop Sci. 34:302–303.  
Orf, J.H., R.A. Scott, and B.W. Kennedy. 1995. Registration of 'Hendricks' soybean. Crop Sci. 35:1226–1227.  
Nowling, G.L. 2000. The uniform soybean tests, northern region. 2000. USDA-ARS, West Lafayette, IN.

J.H. Orf, Dep. of Agronomy and Plant Genetics, R.L. Denny, Dep. of Plant Pathology, Univ. of Minnesota, St. Paul, MN 55108. Work supported in part by grants from the Minnesota Soybean Research and Promotion Council. Contribution from the Minnesota Agric. Exp. Stn. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (orffx001@umn.edu).

Published in Crop Sci. 44:693 (2004).

### Registration of 'Saber' Rice

'Saber' rice (*Oryza sativa* L.) (Reg. no. CV-117, PI 633624), an early-maturing, long-grain cultivar with improved blast and sheath blight resistance, was developed at the Texas A&M Univ. System Agric. Res. & Ext. Ctr. at Beaumont, TX, by the USDA-ARS in cooperation with the Texas Agric. Exp. Stn., the Texas Rice Improvement Assoc., and the Texas Rice Res. Foundation. Saber was officially released in 2001 by the USDA-ARS in cooperation with the Agric. Exp. Stn. of Texas A&M Univ., the Univ. of Arkansas, Louisiana State Univ., and Mississippi State University.

Saber was developed from the cross 'Gulfmont'/RU8703196//Te Qing' (cross number B8910A11) produced at Beaumont in 1989. Gulfmont is an early maturing, semidwarf cultivar with excellent main crop yield and milling quality that was released in 1986 (Bollich et al., 1990). RU8703196 is a long-grain germplasm source that was released in 1995 and has improved resistance to blast and sheath blight diseases (Marchetti et al., 1995). Te Qing (PI 536047) is a medium grain cultivar from China that possesses high amylose content and firm cooking quality that is typical of indica long grains. When grown in the southern USA, Te Qing has been characterized as having high yield potential, medium height, relatively late maturity, and excellent resistance to rice blast disease (caused by *Pyricularia grisea* Sacc. = *P. oryzae* Cavara) and sheath blight disease (caused by *Rhizoctonia solani* Kühn). Saber was developed by a modified pedigree breeding method and was entered into the 1996 Uniform Regional Rice Nurseries under the designation RU9603178 as a bulk of F<sub>8</sub> breeding rows.

The grain dimension of Saber is smaller than its parent, Gulfmont (Table 1), and its endosperm is nonglutinous, nonaromatic, and covered by a light brown pericarp. Like Gulfmont, Saber is characterized as a conventional cooking and processing U.S. long-grain having an intermediate apparent amylose content of 21.0 g kg<sup>-1</sup> and an intermediate gelatinization temperature (70–75°C) as indicated by alkali spreading values of 3 to 5 in 17 g kg<sup>-1</sup> KOH solution.

A unique feature of Saber is its combination of improved resistance to both blast and sheath blight diseases. Greenhouse inoculation tests during 1996 to 2000 demonstrated that Saber is resistant to the same spectrum of races of blast disease as Gulfmont as well as some additional races, IB-1J, IB-17, IC-17, IE-1, and IE-1K. Saber has proven to have a similar level of resistance to field isolates (non-mutant) of race IB-49 like the resistant international differential Usen (Marchetti et al., 1987). DNA analysis has indicated that Saber possesses the same marker alleles that are associated with the *pi-d* and *Pi-k<sup>h</sup>* major genes for blast resistance that are found in Gulfmont and the same marker alleles for the *Pi-b* resistance gene as found in Te Qing. The combination of these three major resistance genes appears to provide excellent resistance to all major races of the blast pathogen that are known to occur in the

**Table 1. Rough, brown, and milled grain dimensions and weight of Saber and Gulfmont long-grain rice cultivars grown at Beaumont, TX, in 1998.**

Class	Length	Width	Thickness	L/W ratio	Weight
	mm				mg
<b>Saber</b>					
Rough	8.61	2.30	1.88	3.74	18.8
Brown	6.57	1.96	1.68	3.35	15.3
Milled	6.10	1.82	1.60	3.35	13.5
<b>Gulfmont</b>					
Rough	9.12	2.57	1.94	3.55	22.9
Brown	7.23	2.25	1.72	3.21	20.0
Milled	7.04	2.09	1.68	3.37	17.8



USA. Saber and Bolivar are the only two U.S. cultivars known to possess the *Pi-b* gene (Fjellstrom et al., 2002). This broad spectrum resistance to the blast pathogen was further substantiated in inoculated nurseries with a mixture of blast pathotypes conducted during 1996 to 2000 and screening for leaf blast symptoms (scale of 0 = immune and 9 = highly susceptible). Saber and Bolivar were rated as 2, Kaybonnet and Madison were rated 1, and Cypress and Gulfmont were rated as 4.

Over 5 yr and in 13 screening nurseries inoculated with sheath blight, Saber has demonstrated improved levels of resistance. On the basis of a scale of 1 = very resistant to 9 = very susceptible, Saber was rated 5.2, whereas Jefferson, Gulfmont, Kaybonnet, Cypress, and Madison averaged 6.2, 7.0, 5.9, 6.8, and 6.5, respectively. In a 2-yr study at Beaumont, yield losses due to sheath blight were very low for Saber (4.5%) as compared with Jefferson (11.2%), Lemont (15.4%), Cypress (9.0%), and Madison (18.8%). In these trials, the level of disease severity (1 = very resistant to 9 = very susceptible) was the lowest for Saber (2.9) as compared with Jefferson (3.4), Lemont (5.9), Cypress (3.8), and Madison (6.0).

Screening results for reaction to narrow brown leaf spot [caused by *Cercospora janseana* (Racib.) O. Const. = *C. oryzae* Miyake] has also indicated that Saber is very resistant (rated 0) as compared to Gulfmont, Jefferson, and Kaybonnet (rated as 4). Saber also appears to have good levels of resistance to brown spot [caused by *Cochliobolus miyabeanus* (Ito & Kuribayashi) Drechs. ex Dastur; anamorph: *Bipolaris oryzae* (Breda de Haan) Shoemaker], leaf smut (caused by *Entyloma oryzae* Syd. & P. Syd.), panicle blight (cause undetermined), and to the physiological disorder straighthead. Thus, the improved level of general disease resistance found in Saber will probably preclude the use of fungicides for control of many common diseases of rice.

Saber is a semidwarf whose mature plant height is 97 cm, similar to Cypress (94 cm). At anthesis, the apiculus is red whereas at maturity, the spikelet and apiculus are straw-colored and awnless. Plants have erect tillers, and the leaves, lemma, and palea are glabrous. Average number of days to 50% flowering (80) and days to harvest (114) are similar to Gulfmont and about 1 wk later than Jefferson. Seedling vigor is better than Gulfmont and similar to Cypress.

In 43 statewide and regional tests conducted during 1996 to 2000, average grain yield (120 g kg<sup>-1</sup> moisture) of Saber was 7337 kg ha<sup>-1</sup>, compared with 7630, 7601, and 7922 kg ha<sup>-1</sup> for Jefferson, Gulfmont, and Cypress, respectively. In these trials, the milling yield (mg g<sup>-1</sup> whole milled kernels: mg g<sup>-1</sup> total milled rice) of Saber averaged 612:673 as compared with Jefferson (589:694), Gulfmont (579:704), and Cypress (622:697). In trials conducted during 1996 to 2000, ratoon crop potential of Saber (3294 kg ha<sup>-1</sup>) was slightly better than Jefferson (2867), Gulfmont (2816), and Cypress (2588). This indicates that Saber is well adapted for production across the southern USA.

Breeder seed of Saber will be maintained by the Texas A&M University System Agric. Res. & Ext. Ctr. at Beaumont. Foundation seed will be available from the Texas Rice Improvement Association, 1509 Aggie Dr., Beaumont, TX 77713-8530. Limited quantities of seed will be available upon request from the corresponding author for at least 5 yr. Recipients of seed are asked to make appropriate recognition if Saber is used in the development of a new cultivar, germplasm, parental line, or genetic stock.

A.M. McCLUNG,\* R.G. FJELLSTROM, C.J. BERGMAN,  
C.A. BORMANS, W.D. PARK, AND M.A. MARCHETTI

## References

- Bollich, C.N., B.D. Webb, M.A. Marchetti, and J.E. Scott. 1990. Registration of 'Gulfmont' rice. *Crop Sci.* 30:1159–1160.
- Fjellstrom, R., A. McClung, A.R. Shank, M.A. Marchetti, C. Bormans, and W.D. Park. 2002. Progress on development of microsatellite markers associated with rice blast resistance genes. p. 43–44. *In* Proc. 29th Rice Tech. Working Group. Little Rock, AR. 24–27 Feb. 2002. Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Crowley, LA.
- Marchetti, M.A., C.N. Bollich, A.M. McClung, J.E. Scott, and B.D. Webb. 1995. Registration of RU87030196 disease resistant rice germplasm. *Crop Sci.* 35:600.
- Marchetti, M.A., X. Lai, and C.N. Bollich. 1987. Inheritance of resistance to *Pyricularia oryzae* in rice cultivars grown in the United States. *Phytopathology* 77:799–804.
- A.M. McClung, R.G. Fjellstrom, C.J. Bergman, and M.A. Marchetti (retired), USDA-ARS, 1509 Aggie Dr., Beaumont, TX 77713-8530; C.A. Bormans and W.D. Park, Borlaug Center for Southern Crop Improvement, Dep. Biochemistry and Biophysics, Texas A&M University, College Station, TX 77843. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (amcclung@ag.tamu.edu).

Published in *Crop Sci.* 44:693–694 (2004).

## Registration of 'Pat' Wheat

'Pat' soft red winter wheat (*Triticum aestivum* L.) (Reg. no. CV-933, PI 631446) was developed by the Arkansas Agricultural Experiment Station. It was released in October 2001 because of its resistance to stripe rust (caused by *Puccinia striiformis* Westend.) and consistently high grain yield under Arkansas conditions. Pat was named in honor of Mr. Pat Sullivan, the first president of the Arkansas Association of Wheat Growers and a long-time leader of the wheat industry in Arkansas.

Pat was derived from a F<sub>2</sub> population received from Dr. Stephen Harrison, Louisiana State University, in a germplasm exchange in 1991. The cross of 'Terral 101'/'2548' (PI 532913) was made in 1990. Terral 101 has the pedigree Coker 71-21/'Blueboy II'/'Coker 65-20\*5/'Wichita' 7\*'Transfer'. The population was grown as a bulk in the F<sub>2</sub> and F<sub>3</sub> generations at Stuttgart, AR, to allow natural selection for wet soil conditions. Single head selections were made in the F<sub>4</sub> bulk and subsequently in an F<sub>4.5</sub> headrow on the basis of plant height, maturity date, plant type, reaction to leaf rust (caused by *P. tritici* Eriks.), and reaction to Septoria leaf blotch (caused by *Septoria tritici* Roberge in Desmaz.). The resulting F<sub>5.6</sub> experimental line was designated as AR 839-27-1-3. During the F<sub>6</sub> generation, it was advanced because of its resistance to *Wheat soilborne mosaic virus* (SBWMV) and *Wheat spindle streak mosaic virus* (WSSMV). During subsequent generations, it was advanced primarily because of good grain volume weight and grain yield under Arkansas conditions. AR 839-27-1-3 was tested in the Arkansas Small Grain Cultivar Performance Trials in 2000, 2001, and 2002 and in the USDA-ARS Uniform Southern and Uniform Eastern Soft Red Winter Wheat nurseries in 2001.

In Jackson County, Arkansas, under natural SBWMV and WSSMV inoculum, Pat was resistant with a rating of 1 on a 0-to-9 scale, compared to the susceptible 'Coker 9663', which rated 7. Pat showed complete resistance (0% infection) to stripe rust in 2002 in an inoculated (race PST-80) screening nursery at Fayetteville, AR, compared with 37% severity on the susceptible Coker 9663. In a naturally infected nursery in Lewisville, AR, Pat had 0% severity of stripe rust and Coker 9663 had 33%. In Arkansas trials in 2000 under natural inoculum, Pat exhibited moderate resistance to leaf rust, similar to

Coker 9663. According to seedling tests conducted by the USDA-ARS Cereal Disease Lab, St. Paul, MN, Pat contains the genes *Lr1*, *Lr3*, *Lr10*, *Lr11*, and *Lr18* plus an unidentified gene(s) for leaf rust resistance. Pat is moderately susceptible to Septoria leaf blotch, similar to Coker 9663 on the basis of a natural infection at Stuttgart, AR, in 2001. Pat is susceptible to powdery mildew (caused by *Blumeria graminis* DC f. sp. *tritici* Ém. Marchal).

Pat is an awned, white-chaffed wheat which is approximately 5 cm taller and 1 d later in maturity than 'Sabbe' (Bacon et al., 2002). Pat is most similar in appearance to 'Shelby' (PI 597882). Both Pat and Shelby are approximately 91 cm tall and have a plant color of 147A in the yellow-green group (as referenced by the Royal Horticultural Society Color Chart). Pat has slightly narrower flag leaves than Shelby and Pat heads approximately 5 d later than Shelby in Arkansas. At maturity, Pat has spikes that are awned, mid-dense, fusiform, and nodding at maturity. The white glumes are glabrous, short (9 mm) and midwide with narrow, oblique shoulders and narrow, acuminate beaks. Kernels are red, short to midlong and midlong; with a small germ; the kernel brush is midsized and midlong; the kernel crease is narrow in width and is mid-deep with rounded cheeks. Kernels on average are 6.3 mm long and 3.0 mm wide with a kernel weight of 32 mg.

On the basis of its grain yield and volume weight in experimental tests, Pat has excellent adaptation in Arkansas. Compared with Sabbe in 27 Arkansas Small Grain Cultivar Performance Tests in 2000, 2001, and 2002, Pat (5032 kg ha<sup>-1</sup>) yielded higher than Sabbe (4808 kg ha<sup>-1</sup>) and had a heavier grain volume weight of 719 kg m<sup>-3</sup> compared to 690 kg m<sup>-3</sup>, for Sabbe. Pat has good winter hardiness for its area of adaptation, showing no winter kill in Arkansas trials from 2000 to 2002. On the basis of data from the eight tests in the 2000, 2001, and 2002 Arkansas Small-Grain Cultivar Performance Trials with substantial lodging (>5%), Pat had 2% lodging compared to 26% for Coker 9663.

Pat was tested for end-use quality characteristics at the USDA-ARS Soft Wheat Quality Lab at Wooster, OH. Results from seven southern U.S. locations, indicate Pat has soft wheat quality similar to the quality check cultivar Mason (milling score of 102.3 for Pat compared with 100 for Mason and baking score of 95.2 for Pat compared with 100 for Mason). Individual quality parameters from these tests indicate micro volume weight of 767 kg m<sup>-3</sup> for Pat and 762 kg m<sup>-3</sup> for Mason, a softness equivalence of 56.3% for Pat compared with 61.0% for Mason, flour protein content of 9.4% for Pat and 9.3% for Mason, flour yield of 73.2% for Pat and 71.1% for Mason, micro alkaline water retention capacity of 53.7% for Pat and 55.7% for Mason, cookie diameter of 17.6 cm for Pat compared to 17.7 cm for Mason, and a cookie top grain score of 3.0 for Pat compared with 4.0 for Mason.

Original Breeder seed (F<sub>5.11</sub>) was derived from a 1.5- by 30.5-m increase strip that was rogued three times. Breeder seed will be maintained by rouging and periodically growing headrows. U.S. Plant Variety Protection under Title V of the PVP (#200200274) was issued 24 Apr. 2003. Classes of seed production are limited to Breeder, Foundation, and Certified. Breeder Seed is maintained by the Arkansas Agricultural Experiment Station, Fayetteville, AR 72701. Small quantities of seed for research purposes are available upon request from the corresponding author.

ROBERT K. BACON,\* JOHN T. KELLY, EUGENE A. MILUS,  
AND CHARLES E. PARSONS

### References

Bacon, R.K., J.T. Kelly, E.A. Milus, and C.A. Parsons. 2002. Registration of 'Sabbe' wheat. *Crop Sci.* 42:1375.

R.K. Bacon and J.T. Kelly, Dep. of Crop, Soil and Environmental Sciences, E.A. Milus, Dep. of Plant Pathology, Univ. of Arkansas, Fayetteville, AR 72701; C.E. Parsons, Dep. of Crop, Soil and Environmental Sciences, Lonoke, AR 72086. Published with the approval of the Director, Arkansas Agric. Exp. Stn. The research was supported in part by grants from the Arkansas Wheat Promotion Board. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (rbacon@uark.edu)

Published in *Crop Sci.* 44:694–695 (2004).

### Registration of 'Deloris' Wheat

'Deloris' hard red winter wheat (*Triticum aestivum* L.) (Reg. no. CV-934, PI 631447) was developed by the Utah Agricultural Experiment Station (UAES) and released in August 2002. Deloris was released to provide a hard red winter wheat with high yield potential, good quality, and resistance to dwarf bunt (caused by *Tilletia controversa* Kühn in Rabenh.) when grown under rainfed conditions of the Intermountain West. Deloris was named in honor of Deloris Stokes, a long-time grower-cooperator of the Utah small grains program and supporter of the UAES.

Previous designations for Deloris were UT2030-32 and UT203032. Deloris is derived from the 1987 cross 'Arbon'/'Hansel'//PI 470329/3/'Weston'/NE7060 (Dewey, 1975; Sunderman and Jennings, 1977; Sunderman et al., 1980). PI 470329 is a 1979 accession from Bitlis, Turkey, with moderate resistance to a composite of races of dwarf bunt (USDA-ARS, National Genetic Resources Program; see <http://www.ars-grin.gov/cgi-bin/npgs/html/obs.pl?1365265>; verified 21 October 2003). NE7060 has the pedigree 'Favorit'/5/'Carpiz'/4/'Jang Kwang'/2/'Atlas 66'/'Comanche'/3/'Velvet' (Clark, 1943; Harlan, 1950; Heyne, 1958). The F<sub>2</sub> through F<sub>5</sub> generations were grown at the Greenville Experimental Farm, North Logan, UT, as bulk populations with selection for desirable height, maturity, vigor, and resistance to common bunt [caused by *Tilletia tritici* (Bjerk.) G. Wint. in Rabenh.]. In each generation, heads from desirable plants were harvested from within the population and seed from harvested heads was bulked. A sample of the bulked seed was planted for the next generation. Plants from the F<sub>5</sub> population were selected based on visual evaluation for desired height, maturity, resistance to common bunt, vigor, and spike characteristics. Two heads were collected from each selected plant. In 1993, an individual F<sub>5.6</sub> head was grown at the Greenville Experimental Farm and inoculated with a race composite of dwarf bunt in the fall and subsequently evaluated for dwarf bunt resistance. A second individual F<sub>5.6</sub> head from the same plant selection was grown at the Bluecreek rainfed experimental farm, Bluecreek, UT. Headrows at Bluecreek were selected for rapid emergence, plant uniformity, and desirable tillering, height, heading date, head shape, and kernel plumpness. Headrows at Bluecreek were then evaluated for dwarf bunt resistance on the equivalent headrow at Greenville, and resistant headrows were harvested from the Greenville nursery. The resulting F<sub>5.7</sub> lines were evaluated for yield and the previously described agronomic traits in an unreplicated plot nursery at Bluecreek in 1994, and in a replicated yield trial at Bluecreek in 1995. From 1996 through 2001, Deloris was tested for yield, maturity, volume weight, lodging, winter survival, protein content, and bread quality in replicated nurseries at six rainfed locations throughout Utah and for reaction to dwarf bunt at Greenville. Deloris was also evaluated in the Western Regional Hard Winter Wheat Nursery from 1996 through 1999. In 1999, 250 heads were selected from F<sub>11</sub> plants and were grown as head rows at Greenville. After roguing to remove off-type rows,

approximately 200 F<sub>5:12</sub> lines were harvested and bulked as Breeder seed in 2000.

The juvenile growth habit of Deloris is semi-erect and coleoptile anthocyanin is absent. Heading date is 2 d earlier (day 155) than 'Utah-100' (day 157) at Greenville (Hole et al., 1997). The flag leaf is lax and flat. Stems are hollow, and the mature plant, at an average height in Utah of 78 cm (36 site years), is 3 cm taller than Utah-100. Deloris is more susceptible to lodging (6-yr average of 33% lodging at Greenville) than Utah-100 (0%) when grown under irrigated conditions, but lodging in Deloris has not been observed under rainfed conditions. Deloris has awned, tan-chaffed (0.6Y/6/3.6 Munsell), oblong, mid-dense, and inclined spike characteristics. The kernel is elliptical, has angular cheeks, with a narrow, mid-deep seed crease, and a medium length brush that is not collared. The kernel phenol reaction is brown.

In the dwarf bunt evaluation nurseries mentioned previously, 'Wanser' (Nelson and Nagamitsu, 1972) was grown as a susceptible check and generally averaged over 85% infection while Deloris exhibited no detectable infection. Resistance to dwarf bunt exhibited by Deloris derives from PI 178383, one of the parents of Hansel (Dewey, 1975), Arbon (Sunderman et al., 1980), and Weston (Sunderman and Jennings, 1977), which contains *Bt-8*, *Bt-9*, *Bt-10*, and an unidentified factor (Goates, 1996). Resistance may also come from PI 470329, which also contains *Bt-8* (Blair Goates, personal communication). The specific resistance genes contained by Deloris have not been determined.

In USDA-ARS greenhouse seedling tests with stripe rust (caused by *Puccinia striiformis* Westend.), Deloris is susceptible both as a seedling and adult plant to races PST-17, PST-37, PST-43, PST-45, and PST-78. In the field, Deloris averaged 30% infection while the susceptible check WB470 averaged 45% infection in tests in 2001 at Mt. Vernon and Pullman, WA.

In replicated field trials conducted in Utah from 1996 to 2001, the grain yield of Deloris averaged 2845 kg ha<sup>-1</sup> (36 site years) compared with 2751 kg ha<sup>-1</sup> for 'Utah-100' (significantly different at  $\alpha = 0.05$ ). From 1997 through 2000 (38 site years), Deloris had a grain yield average of 4916 kg ha<sup>-1</sup> in the Western Regional Hard Winter Wheat Nursery compared with 4318 kg ha<sup>-1</sup> for Wanser and a nursery mean of 5076 kg ha<sup>-1</sup>. Average volume weight for Deloris in the same nurseries was equal to the nursery average (77.7 kg hL<sup>-1</sup>) and slightly lower than Wanser (78.0 kg hL<sup>-1</sup>).

The USDA-ARS Western Wheat Quality Laboratory (WWQL) in Pullman, WA, has evaluated Deloris for milling and bread quality attributes each year since 1994. Average volume weight measured by the WWQL (8 site years) is 79.7 kg hL<sup>-1</sup>. This is about 2 kg hL<sup>-1</sup> higher than Utah-100 and 2 kg hL<sup>-1</sup> lower than Weston. Deloris grain protein (132 g kg<sup>-1</sup>) is similar to Utah-100 (129 g kg<sup>-1</sup>) and Weston (131 g kg<sup>-1</sup>). Deloris has the same mixograph peak time (3.3 min) as Utah-100 and is longer than Weston (2.0 min; significant at  $\alpha = 0.05$ ). Loaf volume is similar to Utah-100 (998 and 989 mL respectively) and Weston (999 mL) with higher flour yield (708 g kg<sup>-1</sup>) than Utah-100 (683 g kg<sup>-1</sup>) or Weston (684 g kg<sup>-1</sup>).

The Utah Crop Improvement Association will maintain Foundation seed of Deloris. U.S. Plant Variety Protection will not be applied for. Recognized seed classes include Foundation, Registered, and Certified. Small amounts of seed for research purposes may be obtained by contacting the corresponding author.

D.J. HOLE,\* D. ROCHE, S.M. CLAWSON, AND S.A. YOUNG

## References

- Clark, J.A. 1943. Registration of improved wheat varieties, XV. J. Am. Soc. Agron. 35:245.
- Dewey, W.G. 1975. Registration of 'Hansel' wheat. Crop Sci. 15:888.
- Goates, B.J. 1996. Common bunt and dwarf bunt. p. 12–25. In R.D. Wilcoxson and E.E. Saari (ed.) Bunt and smut diseases of wheat: Concepts and methods of disease management. CIMMYT, Mexico, D.F.
- Harlan, J.R. 1950. Collection of crop plants in Turkey, 1948. Agron. J. 42:258–259.
- Heyne, E.G. 1958. Registration of improved wheat varieties, XXI. Agron. J. 50:396.
- Hole, D.J., R.S. Albrechtsen, S. Clawson, and S.A. Young. 1997. Registration of Utah-100 wheat. Crop Sci. 37:1009.
- Nelson, W.L., and M. Nagamitsu. 1972. Registration of Wanser wheat. Crop Sci. 12:718.
- Sunderman, D.W. and S. Jennings. 1977. Winter wheat varieties: For dryland and irrigated areas of southern Idaho and irrigated areas of the Treasure Valley, eastern Oregon. Idaho Coop. Ext. Serv. Current Information Ser. No. 408.
- Sunderman, D.W., M.M. Stearns, and J.A. Hoffman. 1980. Registration of 'Arbon' wheat. Crop Sci. 20:825–826.
- D.J. Hole, D. Roche, S.M. Clawson, and S.A. Young, Dep. of Plants, Soils, and Biometeorology, Utah State University, Logan, UT 84322-4820. Utah Agric. Exp. Stn., Journal No. 7498. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (dhole@mendel.usu.edu).

Published in Crop Sci. 44:695–696 (2004).

## Registration of 'AC Andrew' Wheat

'AC Andrew' soft white spring wheat (*Triticum aestivum* L.) (Reg. no. CV-936, PI 632907) was developed by the Lethbridge Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB. It was granted a regional (Manitoba, Saskatchewan, Alberta, and British Columbia) interim registration (no. I-278) on 20 April 2001 by the Variety Registration Office, Plant Health and Production Division, Canadian Food Inspection Agency, Government of Canada. AC Andrew is a bearded, soft white spring wheat adapted to irrigated regions of southern Alberta and southern Saskatchewan.

AC Andrew is an anther-derived doubled haploid line developed from an F<sub>26</sub> line of the cross 'Dirkwin'/SC8021V2// 'Treasure'/'Blanca' made in 1990. Dirkwin (Sunderman et al., 1980), Treasure (Sunderman and O'Connell, 1988), and Blanca (Sunderman et al., 1988) are soft white spring wheat cultivars developed by USDA-ARS and the Idaho Agriculture Experimental Station. SC8021V2 is a sprouting-tolerant white-kernelled germplasm line released by Agriculture and Agri-Food Canada, Swift Current, SK (DePauw et al., 1992).

The F<sub>26</sub> line, used to produce the doubled haploid, was derived via head selection and the bulk method. Single head selections were made in the F<sub>2</sub> population, and the F<sub>3</sub> head rows were grown in a winter nursery near Brawley, CA. Promising F<sub>3</sub> head rows were identified based on plant height, maturity, and resistance to lodging and shattering. Within each of these F<sub>3</sub> head rows, single heads were selected and threshed in bulk. This seed was used to grow the F<sub>4</sub> population at Lethbridge. The process of head selection and bulking was followed until the F<sub>6</sub> generation. Doubled haploids were then produced from one of the F<sub>6</sub> lines (B799) by the anther culture technique (Orshinsky and Sadasivaiah, 1994).

Twenty-six anther-derived doubled haploid lines were evaluated in a preliminary yield test in 1996. From 1997 to 1999, one of the lines, designated 96DH-812, was evaluated as SWS-241 in the Western Soft White Spring Wheat Cooperative Tests conducted at four locations (Lethbridge, Iron Springs, Vauxhall, and Bow Island) in southern Alberta and two locations (Saskatoon and Outlook) in southern Saskatchewan. The widely grown cultivars AC Reed (Sadasivaiah et al., 1993), AC Phil (Sadasivaiah et al., 2000), and AC Nanda (Sadasivaiah et al., 2000) were used as checks.



AC Andrew (8130 kg ha<sup>-1</sup>) out-yielded AC Reed (6880 kg ha<sup>-1</sup>) by 18% and outyielded AC Phil (7070 kg ha<sup>-1</sup>) and AC Nanda (6840 kg ha<sup>-1</sup>) by 15 and 19%, respectively, in 3 yr of testing in the Western Soft White Spring Wheat Cooperative Test. AC Andrew (91.5 cm) is about 5 cm taller than AC Reed and 3 cm shorter than AC Nanda with maturity (112 d) similar to AC Nanda, and 3 to 4 d later than AC Reed and AC Phil. AC Andrew has very good resistance to lodging (1.4 on a scale of 1 to 9) and shattering (1.2 on a scale of 1 to 9).

AC Andrew has a non-pigmented coleoptile and an erect juvenile growth habit. It has a dark green, midwide, midlong, and slightly curved flag leaf. The spikes are erect, oblong, midlong, middense, and white at maturity; awns are midlong and slightly spreading; glumes are midwide and midlong; glume shoulders are midwide and oblique; glume beaks are short and acuminate. The kernels are soft, creamy white, mid-size (36.3 mg), midlong, midwide, and ovate to oval; the germ is midsize, and oval to ovate; the crease is midwide and middeep; cheeks are rounded to angular; brush is midsize and midlong.

AC Andrew is resistant to prevalent races of stripe rust (caused by *Puccinia striiformis* Westend.), stem rust (caused by *P. graminis* Pers.:Pers.) and powdery mildew (caused by *Blumeria graminis* DC. f. sp. *tritici* Em. Marchal), and is moderately resistant to leaf rust (caused by *P. tritici* Eriks.) and kernel black point [caused by *Alternaria alternata* (Fr.:Fr.) Keissl.]. It is susceptible to common bunt [caused by *Tilletia laevis* Kuhn in Rabenh. and *T. tritici* (Bjerk.) G. Wint. in Rabenh.] and highly susceptible to loose smut [caused by *Ustilago tritici* (Pers.) Rostr.]. Plants were inoculated at the appropriate developmental stages with a mixture of races prevalent in western Canada to evaluate resistance to stripe rust, leaf rust, stem rust, loose smut, and common bunt. Resistance to powdery mildew and black point was evaluated under field conditions with natural infection.

The milling and baking properties of AC Andrew were evaluated from 1997 to 1999 by the Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB, using AC Reed, AC Phil, and AC Nanda as check cultivars. The average grain protein content for AC Andrew and AC Nanda (11.4%) was slightly higher than AC Reed (10.9%) and AC Phil (10.67%). AC Andrew had lower volume weight (81.1 kg hL<sup>-1</sup>) than AC Reed (81.6 kg hL<sup>-1</sup>), AC Phil (81.5 kg hL<sup>-1</sup>), and AC Nanda (83.5 kg hL<sup>-1</sup>). The flour yield of AC Andrew (75.1%) was lower than AC Reed (75.8%), AC Phil (75.9%), and AC Nanda (75.8%). The falling number of AC Andrew (355 s) was similar to AC Reed (353 s) and AC Phil (350 s), but higher than AC Nanda (327 s). AC Andrew (406.7 B.U.) had a low amylograph peak viscosity (expressed in Brabender units) compared to AC Reed (493.3 B.U.), AC Phil (AC 488.3 B.U.), and AC Nanda (995.0 B.U.). Cultivars with high amylograph peak viscosity are preferable in some end-uses (e.g., soup thickener). Cookie diameter of AC Andrew (81.4 mm) was smaller than AC Reed (83.4 mm), AC Phil (84.0 mm), and AC Nanda (82.3).

Seed harvested from 183 headrows was increased in 2000 at the Indian Head Experimental Farm to form breeder seed. The Breeder seed of AC Andrew will be maintained by the Agriculture and Agri-Food Canada Experimental Farm, Indian Head, SK., Canada S0G 2K0. The multiplication and distribution of pedigreed seed will be handled by SeCan Association, 201-52 Antares Drive, Ottawa, ON, Canada K2E 7Z1.

R.S. SADASIVAIAH,\* S.M. PERKOVIC, D.C. PEARSON,  
B. POSTMAN, AND B.L. BERES

## References

- DePauw, R.M., T.N. McCaig, J.M. Clarke, J.G. McLeod, R.E. Knox, and M.R. Fernandez. 1992. Registration of sprouting-resistant white-kerneled wheat germplasms SC8019R1 and SC80221V2. *Crop Sci.* 32:838.
- Orshinsky, B.R., and R.S. Sadasivaiah. 1994. Effects of media on embryoid induction and plant regeneration from cultured anthers of soft white spring wheats (*Triticum aestivum* L.). *Plant Sci.* 102:99-107.
- Sadasivaiah, R.S., J.B. Thomas, and R.L. Conner. 1993. Registration of 'AC Reed' Spring Wheat. *Crop Sci.* 33:879.
- Sadasivaiah, R.S., A. Laroche, and J.B. Thomas. 2000. Registration of 'AC Phil' Wheat. *Crop Sci.* 40:580-581.
- Sadasivaiah, R.S., S.M. Perkovic, D.C. Pearson, and B. Postman. 2000. Registration of 'AC Nanda' Wheat. *Crop Sci.* 40:579-580.
- Sunderman, D.W., M.M. Stearns, and L.J. Smith. 1980. Registration of Dirkwin Wheat. *Crop Sci.* 20:826.
- Sunderman, D.W., and B. O'Connell. 1988. Registration of 'Treasure' Wheat. *Crop Sci.* 28:576.
- Sunderman, D.W., J.S. Quick, B. O'Connell, and M.A. Dillon. Registration of 'Blanca' Wheat. 1988. *Crop Sci.* 28: 577.
- Lethbridge Research Centre, Agriculture and Agri-Food Canada, P.O. Box 3000, Lethbridge, AB T1J 4B1, Canada. Development of AC Andrew was partly funded by the Alberta Agricultural Research Institute and Alberta Soft Wheat Producers Commission through a Matching Grants Program (project #97M186), Western Grains Research Foundation and Agriculture and Agri-Food Canada's Matching Investment Initiative program. LRC Contribution No. 387-02105. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (sadash@agr.gc.ca).

Published in *Crop Sci.* 44:696-697 (2004).

## Registration of 'AC Meena' Wheat

'AC Meena' soft white spring wheat (*Triticum aestivum* L.) (Reg. no. CV-935, PI 632906) was developed by the Lethbridge Research Centre, Agriculture and Agri-Food Canada, Lethbridge, Alberta. It was granted a permanent regional (Manitoba, Saskatchewan, Alberta, and British Columbia) registration (no. 5300) on 20 April 2001 by the Variety Registration Office, Plant Health and Production Division, Canadian Food Inspection Agency, Government of Canada. AC Meena is a bearded wheat adapted to irrigated regions of southern Alberta and southern Saskatchewan.

AC Meena was developed from the cross 'AC Reed'/SWS-124 made in 1992. SWS-124 is a selection from the cross 'Owens'/SWS-15//4\* 'Fielder'. SWS-15 is a germplasm line from ICARDA. AC Reed (Sadasivaiah et al., 1993) is a soft white spring wheat cultivar released by Agriculture and Agri-Food Canada, and the cultivars Fielder (Sunderman and Bruinsma, 1975) and Owens (Sunderman and O'Connell, 1984) were released by USDA-ARS and the Idaho Agricultural Experimental Station, Aberdeen, ID. The F<sub>2</sub> to F<sub>4</sub> populations were advanced as bulks with head selections made within each of these generations for semi-dwarf stature, early maturity, and lodging and shattering resistance. Single heads selected in the F<sub>4</sub> bulk population were grown as F<sub>5</sub> head rows in 1994-1995 at the Brawley, CA, winter nursery. The F<sub>6</sub> line, 95WI-4917, was evaluated in a preliminary test in 1995, and in 1996 it was evaluated in an advanced test as PR95-2830. From 1997 to 1999, this line, designated SWS-234, was evaluated in Western Soft White Spring Wheat Cooperative Tests conducted at four locations (Lethbridge, Iron Springs, Vauxhall, and Bow Island) in southern Alberta and two locations (Saskatoon and Outlook) in southern Saskatchewan. The criteria used in the evaluation include grain yield, plant height, maturity, resistance to lodging, shattering and diseases, and end-use quality characteristics. Widely grown cultivars AC Reed, AC Phil (Sadasivaiah et al., 2000a), and AC Nanda (Sadasivaiah et al., 2000b) were used as checks.

In 3 yr of Western Soft White Spring Cooperative Test, AC Meena (7250 kg ha<sup>-1</sup>) yielded 5% more than AC Reed

(6880 kg ha<sup>-1</sup>), and 3 and 6% higher than AC Phil (7070 kg ha<sup>-1</sup>) and AC Nanda (6840 kg ha<sup>-1</sup>). AC Meena has good resistance to lodging (2.2 on a scale of 1 to 9) and shattering (1.2 on a scale of 1 to 9), and matures (110 d) 2 d earlier than AC Nanda (112 d) and 2 to 3 d later than AC Reed and AC Phil. AC Meena (92 cm) is 6 cm taller than AC Reed and 2 cm shorter than AC Nanda.

AC Meena has a nonpigmented coleoptile and erect juvenile growth. It has a midwide, midlong, medium green and slightly curved flag leaf. Spikes are erect, oblong, middense and midlong and white at maturity; awns are midlong and appressed; glumes are midwide, midlong and glabrous; glume shoulders are midwide and oblique; glume beaks are midlong and acuminate; kernels are soft, creamy white, midsize (34.2 mg), midlong, oval to ovate; germ is midsize, oval to ovate; crease is midwide to wide, middeep; cheeks are rounded to angular; brush is mid-size to small and mid-long.

AC Meena is resistant to prevalent races of stripe rust (caused by *Puccinia striiformis* Westend), and moderately resistant to powdery mildew (caused by *Blumeria graminis* DC. f. sp. *tritici* Em. Marchal), and kernel black point [caused by *Alternaria alternata* (Fr.:Fr.) Keissl.]. It is moderately susceptible to leaf rust (caused by *P. tritricina* Eriks.) and stem rust (caused by *P. graminis* Pers.:Pers.), susceptible to common bunt [caused by *Tilletia laevis* Kühn in Rabenh. and *T. tritici* (Bjerk.) G. Wint. in Rabenh.], and highly susceptible to loose smut [caused by *Ustilago tritici* (Pers.) Rostr.]. Plants were inoculated at the appropriate developmental stages with a mixture of races prevalent in western Canada to evaluate resistance to stripe rust, leaf rust, stem rust, loose smut, and common bunt. Resistance to powdery mildew and black point was evaluated under field conditions with natural infection during 1997 to 1999 at four (Lethbridge, Iron Springs, Vauxhall, and Bow Island) locations in southern Alberta.

The milling and baking characteristics of AC Meena were evaluated from 1997 to 1999 by the Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB., using AC Reed, AC Phil, and AC Nanda as checks. AC Meena (10.7%) was similar to AC Reed (10.9%) and AC Phil (10.7%) for protein content, and had lower protein than AC Nanda (11.4%). AC Meena (80.4 kg hL<sup>-1</sup>) had lower volume weight than AC Reed (81.6 kg hL<sup>-1</sup>), AC Phil (81.5 kg hL<sup>-1</sup>), and AC Nanda (83.5 kg hL<sup>-1</sup>). Its flour yield (75.2%) was lower

compared to AC Reed (75.8%), AC Phil (75.9%), and AC Nanda (75.8%). AC Meena (362 s) had a higher falling number than AC Reed (353 s), AC Phil (350 s), and AC Nanda (327 s). The amylograph peak viscosity (expressed in Brabender units) for AC Meena (730.0 B.U.) was higher than that for AC Reed and AC Phil (493.3 and 488.3 B.U., respectively) and lower than that for AC Nanda (995.0 B.U.). Cultivars with high amylograph peak viscosity are preferable in some end-uses (e.g., soup thickener). Cookie spread for AC Meena (82.3 mm) was similar to AC Nanda (82.3 mm), but smaller than AC Reed (83.4 mm) and AC Phil (84.0 mm).

Seed harvested from 281 head rows selected out of 286 planted was bulked and increased at Indian Head in 2000 to form the Breeder seed. The Breeder seed of AC Meena will be maintained by the Agriculture and Agri-Food Canada Experimental Farm, Indian Head, SK, Canada S0G 2K0. Multiplication and distribution of the pedigreed seed will be handled by Haney Farms, P.O. Box 280, Picture Butte, Alberta, T0K 1V0.

R.S. SADASIVAIAH,\* S.M. PERKOVIC, D.C. PEARSON,  
B. POSTMAN, AND B.L. BERES

### References

- Sadasivaiah, R.S., J.B. Thomas, and R.L. Conner. 1993. Registration of 'AC Reed' Spring Wheat. *Crop Sci.* 33:879.  
Sadasivaiah, R.S., A. Laroche, and J.B. Thomas. 2000a. Registration of 'AC Phil' Wheat. *Crop Sci.* 40:580-581.  
Sadasivaiah, R.S., S.M. Perkovic, D.C. Pearson, and B. Postman. 2000b. Registration of 'AC Nanda' Wheat. *Crop Sci.* 40:579-580.  
Sunderman, D.W., and B. Bruinsma. 1975. Registration of four wheat cultivars. *Crop Sci.* 15:104-105.  
Sunderman, D.W., and B. O'Connell. 1984. Registration of Owens Wheat. *Crop Sci.* 24:210-211.  
Lethbridge Research Centre, Agriculture and Agri-Food Canada, P.O. Box 3000, Lethbridge, AB T1J 4B1, Canada. Development of AC Meena was partly funded by the Alberta Agricultural Research Institute and Alberta Soft Wheat Producers Commission through a Matching Grant Program (project #97M186), Western Grains Research Foundation and Agriculture and Agri-Food Canada's Matching Investment Initiative program. LRC Contribution No. 387-02106. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (sadasiah@agr.gc.ca).

Published in *Crop Sci.* 44:697-698 (2004).

## REGISTRATIONS OF GERMPLASMS

### Registration of S97-1688 Soybean Germplasm Line High in Protein Content and Resistant to Soybean Cyst Nematode

Soybean [*Glycine max* (L.) Merr.] germplasm line 'S97-1688' (Reg. no GP-300, PI 633736) was developed at the Delta Center of the University of Missouri, Portageville, MO, and released by The Missouri Agricultural Experiment Station. This line has value as a parent because of its competitive yield potential, higher protein content and broad resistance to populations of races of soybean cyst nematode (SCN), *Heterodera glycines* Ichinohe.

S97-1688 originated as an F<sub>4</sub> single plant selection composited in the F<sub>5</sub> generation from the cross S91-1381 × Hartz 5810. S91-1381 is a selection from Hartz 5370 × 'Hartwig' (Anand, 1992). H5370 is a selection from D70-3115 × 'Forrest' (Hartwig and Epps, 1973). D70-3115 is a sib of 'Centennial' (Hartwig and Epps, 1977). Hartz 5810 is a selection from Hartz 5164 × F<sub>1</sub> (Asgrow brand 'A5474' × PI 90763) (Shannon and

Schillinger, 1989). Hartz 5164 is from 'Bedford' × (D70-3115 × 37-3-16) (Hartwig and Epps, 1978). The line 37-3-16 is a selection from R72-2647<sup>(2)</sup> × (Forrest sib × PI 88788). R72-2647 is a SCN race 1 and 3 resistant 'Lee' type (Hartwig, 1958) derived from the cross R66-1516 × (Forrest sib × PI 88788). R66-1516 is from Lee<sup>(5)</sup> × FC33243. The F<sub>1</sub> generation was grown in Puerto Rico in 1994. The F<sub>2</sub> and F<sub>3</sub> generations were advanced in 1995 by modified single seed descent in the cyst nursery, a SCN race 5 infested field at the University of Missouri Rhodes Farm, Clarkton, MO, and in Puerto Rico, respectively. The F<sub>4</sub> was grown again in the cyst nursery in 1996. Single plants were harvested and individually screened in the greenhouse against a mixture of SCN races 2, 3, and 5. SCN resistant F<sub>5</sub> plant rows were grown in the field at Portageville in 1997 and single rows uniform for agronomic traits were bulked for yield tests. S97-1688 was screened for resistance to individual SCN races 1, 2, 3, 5, and 14 at Portageville and Columbia, MO, as well as Jackson, TN. S97-1688 is mid-group

V maturity (RM5.6), about 1 d earlier than 'Hutcheson' (Buss et al., 1988). It was tested in Missouri from 1998 to 2000 and was evaluated in the Uniform Group V Soybean Tests-Southern States from 1999 to 2000 (Tyler, 1999; Paris and Shelton, 2000). In 25 tests, yield of S97-1688 was 2% less and plants averaged 8 cm taller than Hutcheson. In addition, it was evaluated in the Regional Group V High Protein Test in 2000 (Graef, 2000). In six tests, yield of S97-1688 averaged 6% more and plants averaged 9 cm taller than Hutcheson. S97-1688 has white flowers, tawny pubescence, and tan pods at maturity. Seeds are shiny yellow with black hila. Seed size averaged 11.5 mg seed<sup>-1</sup> versus 13.0 mg seed<sup>-1</sup> for Hutcheson (Tyler, 1999; Paris and Shelton, 2000). Seed composition on a dry weight basis averaged 445 g kg<sup>-1</sup> protein and 185 g kg<sup>-1</sup> oil compared to 419 g kg<sup>-1</sup> protein and 205 g kg<sup>-1</sup> oil for Hutcheson (Tyler, 1999; Paris and Shelton, 2000). S97-1688 is resistant to populations of SCN races 1, 2, 3, 5, and 14. Resistance to SCN traces to PI 437654 through Hartwig. Therefore, S97-1688 could have resistance to other populations of SCN including races 4, 6, 9, and 12, but it has not been tested. S97-1688 is moderately susceptible to sudden death syndrome [caused by *Fusarium solani* (Mort.) Sacc. f. sp. *glycines* Roy]. It is susceptible to root knot nematodes (*Meloidogyne* spp.) and to stem canker [caused by *Diaporthe phaseolorum* (Cooke and Ellis) Sacc. var. *meridionales* F.A. Fernandez], and *Soybean mosaic virus*.

Small quantities of seed may be obtained from the corresponding author for at least 5 yr.

S.C. ANAND, J.G. SHANNON,\* J.A. WRATHER,  
P.R. ARELLI, D.A. SLEPER, AND L.D. YOUNG

### References

- Anand, S.C. 1992. Registration of Hartwig soybean. *Crop Sci.* 32: 1069-1070.  
Buss, G.R., H.M. Camper, Jr., and C.W. Roane. 1988. Registration of Hutcheson soybean. *Crop Sci.* 28:1024-1025.  
Graef, G.L. 2000. 2000 Regional high protein test report group II-V. Department of Agronomy, University of Nebraska, Lincoln, NE.  
Hartwig, E.E., and J.M. Epps. 1973. Registration of Forrest soybeans. *Crop Sci.* 13:287.  
Hartwig, E.E., and J.M. Epps. 1977. Registration of Centennial soybeans. *Crop Sci.* 17:979.  
Hartwig, E.E. 1958. Registration of Lee soybeans. *Agron. J.* 50:690-691.  
Hartwig, E.E., and J.M. Epps. 1978. Registration of Bedford soybeans. *Crop Sci.* 18:915.  
Paris, R.L., and G.W. Shelton. 2000. Uniform soybean tests-Southern states 2000. USDA-ARS, Stoneville, MS.  
Shannon, J.G., and J.A. Schillinger. 1989. Registration of A5474 soybean. *Crop Sci.* 29:1091.  
Tyler, J.M. 1999. Uniform soybean tests-Southern states 1999. USDA-ARS, Stoneville, MS.

S.C. Anand and D.A. Sleper, Dep. of Agronomy, 210 Waters Hall, University of Missouri, Columbia, MO 65211; J.G. Shannon and J.A. Wrather, University of Missouri-Delta Center, P.O. Box 160, Portageville, MO 63873; P.R. Arelli, USDA-ARS, 605 Airways Blvd., Jackson, TN, 38301; L.D. Young, USDA-ARS, P.O. Box 345, Stoneville, MS 38776. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (shannon@missouri.edu).

Published in *Crop Sci.* 44:698-699 (2004).

### Registration of 10 Determinate Semidwarf Soybean Germplasm Lines

Ten semidwarf soybean [*Glycine max* (L.) Merr.] germplasm lines (Reg. no. GP-287-GP-296, PI 632422-632431) were developed by the USDA-ARS in cooperation with the

**Table 1. Description, pedigree, and Phytophthora resistance gene of released semidwarf soybean breeding lines.**

Line	Maturity group	Pedigree	Rps gene
HC94-1946	III	Charleston × HC74-634BC	
HC95-634	III	HC85-603 × Sprite-Rps1b	<i>Rps1b</i>
HC94-35PR	III	Charleston (5) × Sprite-87	<i>Rps1k</i>
HC98-303	III	HC89-1640 × Charleston BC	<i>Rps1k</i>
HC96-45PR	III	HC85-6723 (4) × HC78-676BC	<i>Rps1k</i>
HC97-4358	III	Charleston BC × HC89-868 C	<i>Rps1k</i>
HC94-944	IV	HC85-606 × HC78-676BC	
HC95-933	IV	Sprite 87 × Conrad	
HC95-261PR	IV	HC87-5844 (4) × HC78-676BC	<i>Rps1k</i>
HC94-168	IV	Charleston × Pella 86	

Ohio Agricultural Research and Development Center at Wooster, OH, and were released in 2002 (Table 1). The pedigrees of the parent lines are indicated in Table 2.

Semidwarf soybean cultivars have been developed to overcome the lodging barrier to higher soybean yields (Cooper, 1971, 1981b, 1985). The first semidwarf cultivar, 'Elf' was released in 1977 (Cooper, 1981a). There have been 19 subsequent semidwarf cultivars released with the most recent releases being, 'Charleston', 'Troll', 'Stout', 'Strong', 'Apex', and 'Stalwart' (Cooper et al., 1995, 2001a, 2001b, 2001c, 2003, 2004).

These germplasm lines were released to supplement released semidwarf cultivars for use as basic breeding material in a semidwarf breeding program or for use in conventional breeding programs. These determinate semidwarf lines carry the *dtl* gene for determinancy and the *e1* gene for early flowering (*dt1e1*), characteristic of all Midwestern maturity semidwarf cultivars (Cooper 1981b, 1985). In contrast, southern determinate cultivars carry the *dt1E1* gene, and northern indeterminate cultivars carry the *Dt1e1* gene.

Semidwarf cultivars are specifically adapted to high yield environments where lodging can limit the yield of taller indeterminate cultivars (Cooper, 1971, 1981b, 1985). They are well suited to uniformly high yielding soils and to irrigated production. Because of their specific adaptation to high yield environments, semidwarf cultivars are uniquely suited to site-specific-farming, which is the practice of planting the semidwarf cultivars in the high yielding areas of a field and taller, more drought tolerant cultivars in the lower yielding areas to increase the overall field average yield. Semidwarf cultivars should be solid-seeded in 17- to 20-cm row spacing at a seeding rate of 750 000 seeds/ha to maximize their yield potential (Cooper, 1981b, 1985). Semidwarf genotypes are not recommended for lower yielding environments (<3335 kg/ha), where they may be too short for efficient harvest.

All of these lines have been yield tested intensively in Ohio and in the Northern Uniform Regional Tests (Wilcox, 2000) and have shown desirable agronomic characteristics and good yield potential (6000 kg/ha in irrigated environments). Release of these lines significantly broadens the genetic base for semidwarf soybean germplasm for future breeding.

These lines have been added to the USDA Soybean Germplasm Collection at Urbana, IL, and small quantities of seed can be obtained by contacting Dr. Randal Nelson, Curator of the Germplasm Collection, Dep. of Crop Science, University of Illinois, Urbana, IL 61801. All lines will also be deposited in the USDA-ARS National Seed Storage Laboratory at Fort Collins, CO. These lines are available for research purposes, including development and commercialization of new cultivars. Appropriate recognition of the source is requested when these germplasm lines contribute to the development of a new breeding line or cultivar.

R.L. COOPER\* AND T. MENDIOLA



**Table 2. Pedigree of parent lines.**

Parent line pedigree
HC74-634BC HC74-634(6) × Williams 82
HC74-634 Williams × Ransom
HC85-603 Sprite 87 × Asgrow 3127
Sprite Rps-1b Sprite(6) × PI86050
HC89-1640 Sprite 87 (2) × HC83-232
HC83-232 Pixie × PI 229.358
Charleston BC Charleston (6) × Sprite 87
HC85-6723 HC74-634 × HC78-676
HC78-676 L70T543G × L74D-619
L74D-619 Williams × Ransom
L70T-543G L15 × Amsoy 71
L15 Wayne (6) × Clark 63
HC78-676 BC HC78-676 (6) × Williams 82
HC89-868 HC78-676BC × HC74-634BC
HC85-606 Sprite × Asgrow 3127
HC87-5844 Pixie × HC78-676

### References

- Cooper, R.L. 1971. Influence of early lodging on yield of soybean [*Glycine max* (L.) Merr.] Agron. ET J. 63:449–450.
- Cooper, R.L. 1981a. Registration of 'Elf' soybean (Reg. No. 150). Crop Sci. 21:633–634.
- Cooper, R.L. 1981b. Development of short statured soybean cultivars. Crop Sci. 21:126–131.
- Cooper, R.L. 1985. Breeding semidwarf soybean cultivars. In J. Janick (ed.) Plant Breeding Rev. 3:289–309.
- Cooper, R.L., R.J. Martin, S.K. St. Martin, A. Calip-DuBois, R.J. Fioritto, and A.F. Schmitthenner. 1995. Registration of 'Charleston' soybean. Crop Sci. 35:592.
- Cooper, R.L., T. Mendiola, S.K. St. Martin, R.J. Fioritto, A.F. Schmitthenner, and A.E. Dorrance. 2001a. Registration of 'Troll' soybean. Crop Sci. 41:922–923.
- Cooper, R.L., T. Mendiola, S.K. St. Martin, R.J. Fioritto, A.F. Schmitthenner, and A.E. Dorrance. 2001b. Registration of 'Stout' soybean. Crop Sci. 41:922.
- Cooper, R.L., T. Mendiola, S.K. St. Martin, R.J. Fioritto, A.F. Schmitthenner, and A.E. Dorrance. 2001c. Registration of 'Strong' soybean. Crop Sci. 41:921–922.
- Cooper, R.L., T. Mendiola, and S.K. St. Martin. R J. Fioritto, and A.E. Dorrance. 2004. Registration of 'Stalwart' soybean. Crop Sci. 44 (in press).
- Cooper, R.L., T. Mendiola, S.K. St. Martin, R.J. Fioritto, and A.E. Dorrance. 2003. Registration of 'Apex' soybean. Crop Sci. 43:1563.
- Wilcox, J.R. 2000. The UniformTests, Northern Region. USDA/ARS, Purdue University, West Lafayette, IN.

USDA/ARS and Dep. Hort. and Crop Sci., OARDC, Wooster, OH 44691. Research support was provided by the USDA/ARS and state and federal funds appropriated to the OARDC, The Ohio State University. Manuscript no. HCS-03-09. Registration by CSSA Accepted 31 May 2003. \*Corresponding author (cooper.16@osu.edu).

Published in Crop Sci. 44:699–700 (2004).

### Registration of GA96-211 Upland Cotton Germplasm Line

GA96-211 cotton (*Gossypium hirsutum* L.) (Reg. no. GP-776, PI 633019) germplasm line was developed by the Georgia Agricultural Experiment Station (GAES) and released in 2003. GA96-211 possesses resistance to Fusarium wilt [caused by *Fusarium oxysporum* Schlechtend.:Fr. f. sp. *vasinfectum* (Atk.) W.C. Snyder & H.N. Hans.], combined with resistance and tolerance to root-knot nematode [*Meloidogyne incognita* (Kofoed & White) Chitwood], plus it has desirable fiber quality.

The pedigree of GA96-211 is GA77-27/PD-3//GA88-92/3/M-240-RNR/4/M-120-RNR/5/LA887. GA77-27 and GA88-92 are unreleased germplasm lines with pedigrees PD4381/Coker 310-9901 and 'Deltapine 90'/GA77-27, respectively. PD-3 is a

cultivar with pedigree PD9363/PD9240 (Culp et al., 1988). M-120-RNR and M-240-RNR are germplasm lines highly resistant to root-knot nematode (Shepherd et al., 1996), while LA887 is a cultivar with moderate resistance to root knot nematode (Jones et al., 1991). The pedigrees of M-120-RNR, M-240-RNR, and LA887 are Auburn-634-RNR/3\*Coker 201, Auburn-634-RNR/3\*Deltapine 61', and LA 434-RKR/'DES119', respectively.

GA96-211 is the result of a long-term forward crossing approach to develop root-knot nematode resistant germplasm adapted to the southeastern USA. The three-way cross of GA77-27/PD-3//GA88-92 was mated with M-240-RNR, followed by multiple generations of pedigree selection for root-knot nematode resistance in infested fields. Reaction to root-knot nematode was inferred from root galling compared with that of susceptible checks under natural infestations of root-knot occurring in the field. Subsequently, a descendent of this effort was mated with M-120-RNR followed by mating a descendent of this cross with LA887. Intervening generations of pedigree selection for root-knot resistance were practiced between crosses with M-120-RNR and LA887. The multiple doses of root-knot resistance in the pedigree of GA96-211 reflect the need to reintroduce genes conferring resistance after their dilution from out-crossing under open-pollination or loss from segregation. GA96-211 derives from the bulk increase of an advanced generation plant selection made after the last cross with LA887 and verified to be resistant to root-knot nematode in field trials and in greenhouse challenge experiments. Crossing and field selection for root-knot resistance were completed by S.H. Baker.

GA96-211 is tolerant of root-knot nematode because it produced similar lint yields in fumigated (1,3-dichloropropene 32.7 L ha<sup>-1</sup>) and nonfumigated plots in field trials conducted in 2001 (1038 kg ha<sup>-1</sup> in fumigated and 1113 kg ha<sup>-1</sup> in nonfumigated plots;  $P > 0.10$ ) and 2002 (1387 kg ha<sup>-1</sup> in fumigated and 1390 kg ha<sup>-1</sup> in nonfumigated plots;  $P > 0.10$ ; Davis and May, 2003). In contrast, non-root knot nematode resistant 'Deltapine 5415' yielded significantly less in nonfumigated plots compared with fumigated plots in the same field trials conducted in 2001 (922 kg ha<sup>-1</sup> in fumigated and 744 kg ha<sup>-1</sup> in nonfumigated plots;  $P < 0.05$ ) and 2002 (1641 kg ha<sup>-1</sup> in fumigated and 1308 kg ha<sup>-1</sup> in nonfumigated plots;  $P < 0.05$ ). Densities of *M. incognita* at harvest in the same field trials revealed that GA96-211 allowed significantly ( $P < 0.05$ ) less root-knot reproduction (182 and 80 J2 150 cm<sup>-3</sup> soil in 2001 and 2002, respectively) compared with Deltapine 5415 (663 and 283 J2 150 cm<sup>-3</sup> soil in 2001 and 2002, respectively) in non-fumigated plots, demonstrating resistance of GA96-211 to root-knot nematode. Results of two greenhouse challenge experiments further confirm resistance of GA96-211 to root-knot because it supported 54% less root-knot nematode reproduction ( $P < 0.05$ ) compared with non-root knot nematode resistant Deltapine 5415 (Davis and May, 2003).

In the relative absence of root-knot nematode, lint yields of GA96-211 were not different than those of Deltapine 5415 in 16 trials of the 2001 and 2002 University of Georgia Official Cultivar Trials (Day et al., 2002; Day et al., 2003). Lint fraction of GA96-211 averaged 2 to 3% less ( $P < 0.01$ ) than that of Deltapine 5415 in the same trials. GA 96-211 has petiole, vein, and leaf margin trichome densities similar to those of Deltapine 5415, but GA96-211 has more dense interveinal trichomes.

GA96-211 has longer upper half mean fiber length (UHM) and lower micronaire readings compared with certain popular cultivars, both desirable fiber characteristics to meet require-

ments of modern yarn manufacturing technologies (Steadman, 1997). The UHM of GA96-211 was 3 to 5% longer ( $P < 0.10$ ) than that of Deltapine 5415 and Deltapine 458BR in the irrigated and rain-fed 2001 and 2002 University of Georgia Later Maturity Official Cultivar Trials (Day et al., 2002; Day et al., 2003). Micronaire readings of GA96-211 (4.4–4.5) were lower ( $P < 0.10$ ) than those of either Deltapine 5415 (4.8–5.1) or Deltapine 458BR (4.8–5.1) in the same trials.

GA96-211 is resistant to Fusarium wilt. Seasonal percent wilted plants of GA96-211 were the same as that of the resistant germplasm line M-315-RNR (Shepherd et al., 1996) for 2 yr in the National Cotton Fusarium Wilt Test (Glass et al., 2001, 2002).

Seed of GA96-211 will be maintained by the GAES. Small quantities of seed (25 g) may be requested from the corresponding author. Requests for seed from outside the USA cannot be filled without an import certificate allowing the seed to enter the requestor's country. The University of Georgia may not be able to certify that seed of GA96-211 is free of certain insects and pathogens specified on an import certificate, and in such instances seed of GA96-211 cannot be supplied. Recipients of seed are asked to make appropriate recognition of the source of the germplasm if it is used in the development of a new cultivar, germplasm, parental line, or genetic stock.

O.L. MAY,\* R.F. DAVIS, AND S.H. BAKER

### Acknowledgments

The authors thank Larry Thompson, Grant Henderson, and Stephen Walker for technical assistance.

### References

- Culp, T.W., R.F. Moore, L.H. Harvey, and J.B. Pitner. 1988. Registration of 'PD-3' cotton. *Crop Sci.* 28:190.
- Davis, R.F., and O.L. May. 2003. Relationships between tolerance and resistance to *Meloidogyne incognita* in cotton. *J. Nematol.*, in press.
- Day, J.L., A.E. Coy, W.D. Branch, O.L. May, S.S. LaHue, and L.G. Thompson. 2002. Georgia 2001 peanut, cotton and tobacco performance tests. Rep. 677. Georgia Agric. Exp. Stn., Athens, GA.
- Day, J.L., A.E. Coy, S.S. LaHue, L.G. Thompson, P.A. Rose, and J.P. Beasley. 2003. Georgia 2001 peanut, cotton, and tobacco performance tests. Rep. 686. Georgia Agric. Exp. Stn., Athens, GA.
- Glass, K.M., W.S. Gazaway, and E. Van Santen. 2001. 2001 National cotton fusarium wilt report. Rep. 158. Alabama Agric. Exp. Stn., Auburn, AL.
- Glass, K.M., W.S. Gazaway, and E. VanSanten. 2002. 2002 national cotton fusarium wilt report. Auburn Agric. Exp. Stn., Auburn, AL. <http://www.ag.auburn.edu>.
- Jones, J.E., J.I. Dickson, W. Aguiard, W.D. Caldwell, S.H. Moore, R.L. Hutchinson, and R.L. Rogers. 1991. Registration of 'LA 887' cotton. *Crop Sci.* 31:1701.
- Shepherd, R.L., J.C. McCarty, Jr., J.N. Jenkins, and W.L. Parrott. 1996. Registration of nine cotton germplasm lines resistant to root-knot nematode. *Crop Sci.* 36:820.
- Steadman, R.G. 1997. Cotton testing. *Textile Progress* 27(1). The Textile Institute, Manchester, UK.

O.L. May, Dep. Crop & Soil Sci., Univ. Georgia, Coastal Plain Station, P.O. Box 748, Tifton, GA 31793-0748; R.F. Davis, Dep. Plant Pathology, Univ. Georgia, 2106 Miller Plant Sci. Bldg., Athens, GA 30602; and S.H. Baker (retired), Dep. Crop & Soil Sci., Univ. Georgia, Coastal Plain Station, P.O. Box 748, Tifton, GA 31793-0748. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (lmay@tifton.uga.edu).

### Registration of VS94-11, VS94-12, and VS94-21 Soybean Germplasm Lines Resistant to Corn Earworm Foliar Damage

Soybean [*Glycine max* (L.) Merr.] germplasm lines VS94-11 (Reg. no. GP-297, PI 632747), VS94-12 (Reg. no. GP-298, PI 632748), and VS94-21 (Reg. no. GP-299, PI 632749) with resistance to corn earworm (CEW) (*Helicoverpa zea* Boddie) foliar damage were developed and released by Virginia State University, Agricultural Research Station, Petersburg, VA. The release of these new germplasm lines VS94-11, VS94-12, and VS94-21 includes additional resistant parentage that will increase genetic diversity. The broad range of resistance exhibited by Plant Introductions (PIs) 171451, 227687, and 229358 has enhanced their usefulness in breeding programs. However, they are all from late maturity groups (VII and VIII) and represent a relatively narrow genetic base from which to select for resistance.

VS94-11 and VS94-12 were derived from  $F_2$  plant selections from a cross between L76-0049  $\times$  'Essex' and VS94-21 was derived from a cross between 'York'  $\times$  PI 416937 (Smith and Camper, 1973; Smith, 1968). At seed maturity, the selected  $F_2$  plants were harvested and threshed individually, and advanced to  $F_3$ . The selections were advanced to the  $F_5$  generations by a single seed descent method (Brim, 1966).  $F_5$  single plants were selected at random and threshed individually. Breeding lines that produced high seed yield were identified from the bulk  $F_6$  plant rows for subsequent yield trials. PI 416937 is from Japan, maturity group (MG) VI, and is reported to have resistance to insect defoliation, drought and aluminum toxicity (Carter and Ruffy, 1992; Kraemer et al., 1990). Line L76-0049 (MG V) was selected for its resistance to insect defoliation (Kraemer et al., 1988, 1990; Elden et al., 1982), and is from the cross 'Williams'  $\times$  PI 171451 (Bernard and Lindahl, 1972; Rufener et al., 1986).

The germplasm lines VS94-11, VS94-12, and VS94-21 were evaluated in 1996-1998 for CEW damage in replicated trials at the Virginia State University, Randolph Research Farm, near Petersburg, VA, by methods described by Kraemer et al. (1997) and Kraemer (2001). Foliage was collected when plants reached the R1 development stage (Fehr et al., 1971). Two neonate CEW larvae were placed on the foliage in Petri dishes and incubated in an environmental chamber. After 10 d, the larvae were weighed and mortality was determined. The mean CEW larval weight of the resistant check L76-0049 was 81 mg. In contrast, mean larval weight of the susceptible standard genotypes, PI 399055 and Essex, were 169 and 157 mg, respectively. The mean CEW weights of VS94-11, VS94-12, and VS94-21 were 85, 55, and 94 mg, respectively. These lines had significantly ( $P < 0.05$ ) lower mean corn earworm weights than the susceptible standard genotypes in each of three growing seasons (Mebratu et al., 2002).

The two germplasm lines VS94-12 and VS94-21 are MG VI and VS94-11 is MG V. The germplasm lines VS94-11 and VS94-12 have white flowers, gray pubescence, yellow seed coat, brown hila and tan pod walls whereas VS94-21 has purple flowers, gray pubescence, yellow seed coat, brown hila, and tan pod walls. The germplasm line VS94-11 has a plant height of 79 cm with a seed size of 11.6 g, VS94-12 has a height of 68 cm and seed size of 12.2 g, and VS94-21 has a height of 74 cm and seed size of 14.2 g. The 2-yr mean seed yields of VS94-11, VS94-12, and VS94-21 were 2460, 2661, 3438 kg ha<sup>-1</sup>, respectively. Germplasm lines VS94-11 and VS94-12 were also entered in the USDA Mid-Atlantic Cooperative Soybean Yield Test during 1994, and VS94-21 in 1995 and produced seed yield equal to the standard checks 'Stafford' (2882 kg

ha<sup>-1</sup>) and 'Twiggs' (2237 kg ha<sup>-1</sup>) (Buss and Camper, 1987; Frey et al., 1988).

The seed of VS94-11 contained 389 g kg<sup>-1</sup> protein and 183 g kg<sup>-1</sup> oil. VS94-12 had 371 g kg<sup>-1</sup> protein, 192 g kg<sup>-1</sup> oil, and VS94-21 had 373 g kg<sup>-1</sup> protein and 158 g kg<sup>-1</sup> oil.

These genetic materials are available for research purposes, including the development and commercialization of new cultivars. Upon written request, packets of 50 seeds of VS94-11, VS94-12, and VS94-21 may be obtained from Dr. Tadesse Mebrahtu, Agricultural Research Station of Virginia State University, P. O. Box 9061, Petersburg, VA 23806. It is requested that appropriate recognition be made if these germplasm lines contribute to the development of new breeding line or cultivar.

T. MEBRAHTU\* AND M. KRAEMER

### References

- Bernard, R.L., and D.A. Lindahl. 1972. Registration of 'Williams' soybean. *Crop Sci.* 12:716.
- Brim, C.A. 1966. A modified pedigree method of selection in soybean. *Crop Sci.* 6:220.
- Buss, G.R., and H.M. Camper, Jr. 1987. Registration of 'Stafford' soybean. *Crop Sci.* 27:1092.
- Carter, T.E., Jr., and T.W. Ruffy, Jr. 1992. Soybean Plant Introductions exhibiting drought and aluminum tolerance. p. 335–346. In C.G. Kuo (ed.) *Adaptation of food crops to temperature and water stress. Proceedings of an International Symposium, Taiwan.* 13–18 Aug. 1992. Pub. 93–410. Asian Vegetable Research and Development Center, Shanhua, Taiwan.
- Elden, T.C., R.L. Bernard, C.R. Edwards, and M. Kogan. 1982. Notice of release of five lines of soybean resistance to Mexican bean beetle. *Plant Resist. Insects Newl.* 8:22.
- Fehr, W.E., C.E. Caviness, P.T. Burmood, and J. Pennington. 1971. [*Glycine max* (L.) Merr.] Stage of development description of soybeans. *Crop Sci.* 11:929–931.
- Frey, K.J., M.D. Simons, L.J. Michel, J.P. Murphy, and J.A. Browning. 1988. Registration of 'Twiggs' soybean. *Crop Sci.* 28:375.
- Kraemer, M.E. 2001. Insect resistance in vegetable and tofu soybeans. *J. Entomol. Sci.* 36:57–66.
- Kraemer, M.E., M. Rangappa, T. Mebrahtu, and P.S. Benepal. 1988. Field evaluation of soybean for Mexican bean beetle resistance. I. Maturity Groups VI, VII, and VIII. *Crop Sci.* 28:497–499.
- Kraemer, M.E., M. Rangappa, T. Mebrahtu, and P.S. Benepal. 1990. Field evaluation of soybean for Mexican bean beetle resistance. II. Maturity Groups III, IV, and V. *Crop Sci.* 30:374–377.
- Kraemer, M.E., M. Rangappa, and A. Mohamed. 1997. Evaluation of vegetable soybean genotypes for resistance to corn earworm (Lepidoptera: Noctuidae). *J. Entomol. Sci.* 32:25–36.
- Mebrahtu, T., M. Kraemer, and T. Andebrhan. 2002. Evaluation of soybean breeding lines for corn earworm antibiosis. *Crop Sci.* 42:1465–1470.
- Rufener, G.K.I.I., R.B. Hammond, R.L. Cooper, and S.K. St. Martin. 1986. Mexican bean beetle (Coleoptera: Coccinellidae) development on resistant and susceptible soybean lines in the laboratory and relationship to field selection. *J. Econ. Entomol.* 79:1354–1358.
- Smith, T.J. 1968. Registration of 'York' soybean. *Crop Sci.* 8:776.
- Smith, T.J., and H.M. Camper. 1973. Registration of 'Essex' soybean. *Crop Sci.* 13:495.
- rust [caused by *Puccinia triticina* Eriks. = *P. recondita* Roberge ex Desmaz. f. sp. *tritici* (Eriks. & E. Henn.) D.M. Henderson] developed cooperatively by the ARS, USDA, the Kansas Agricultural Experiment Station, and the Wheat Genetics Resource Center. It was released as germplasm August 2000.
- KS00WGRC44 is a BC<sub>2</sub> F<sub>6</sub>-derived line with the pedigree 'TAM 107'\*3/TA 1715. TAM 107 is a hard red winter wheat cultivar (Porter et al., 1987), and TA 1715 is a leaf rust resistant accession of *Aegilops tauschii* Coss. collected in Iran. The F<sub>1</sub> hybrids between TAM 107 and TA 1715 were produced in the greenhouse in 1995 using TAM 107 as the female parent. F<sub>1</sub> embryos were rescued on artificial media (Gill and Raupp, 1987) and F<sub>1</sub> plants were backcrossed as females to TAM 107. The BC<sub>1</sub> F<sub>1</sub> plants were backcrossed as females to TAM 107 and the BC<sub>2</sub> F<sub>1</sub> plants were grown in the greenhouse to produce the BC<sub>2</sub> F<sub>2</sub> generation. The pedigree breeding method was used to develop the BC<sub>2</sub> F<sub>6</sub>-derived line with selection in the field and greenhouse for leaf rust resistance and recurrent parent plant type.
- Seedlings of KS00WGRC44 exhibited a low infection type of small necrotic uredinia [IT = 1 or lower on a scale of 0 to 4 (Roelfs et al., 1992)] when inoculated with 15 races of leaf rust, CBB-10,18, CDB-10, KDB-10, LBB-10,18, MCR-10, MCD-10, MBG-10,18, MBR-10, MFB-10, PBB-10, PBJ-10, PNM-10,18, TBD-10, TCR-10, and TFG-10 (Long and Kolmer, 1989). High infection types of 3 to 4 (moderate to large uredinia, lacking chlorosis or necrosis) were observed on seedlings of TAM 107 with all the races of leaf rust tested. Adult plants of KS00WGRC44 displayed a hypersensitive fleck (IT = ; ) level of resistance when exposed to moderate to heavy leaf rust inoculum levels in the field at Manhattan and Hutchinson, KS, in 1999, 2000, and 2001 and under heavy inoculum pressure at Uvalde and Beaumont, TX, in 2000.
- Leaf rust resistance in KS00WGRC44 is due to a single dominant gene from TA 1715. Differences in infection type of seedlings when inoculated with diverse isolates of *P. triticina* indicate that the gene in KS00WGRC44 is different from the *Ae. tauschii*-derived genes *Lr32*, *Lr39*, *Lr41*, and *Lr42*. KS00WGRC44 had a lower infection type of 1 (flecks with small necrotic uredinia) when inoculated with leaf rust race PNM-10,18 at the seedling stage than that observed on the lines TA 4186 (*Lr39*; IT = 4) and KS90WGRC10 (*Lr41*; IT = 3C, moderate size uredinia with chlorosis). When seedlings of KS00WGRC44 and RL5713 (*Lr32*) were inoculated with the TFG-10 race of leaf rust, ITs 0 (no visible infection) and 2+ (small to moderate size uredinia with chlorosis) were observed, respectively. When inoculated with race KDB-10, seedlings of KS91WGRC11 (*Lr42*) had an IT 2C (small uredinia with chlorosis) while no sporulation was observed on seedlings of KS00WGRC44 (IT = ; ). Absence of the 1.36-kb fragment amplified by the primer pair KSUD14, which corresponds to a portion of the cloned *Lr21* gene, indicates that the gene in KS00WGRC44 is different from *Lr21* (Huang et al., 2003).
- When evaluated in replicated field plots at Manhattan and Hutchinson, KS, in the 2000 and 2001 growing seasons, the heading date of KS00WGRC44 was within one day of the recurrent parent. The mean yield and test weight of KS00WGRC44 was not significantly different than that of TAM 107. However, KS00WGRC44 was significantly taller than TAM 107 (110 vs. 102 cm, respectively).
- Small quantities (2 g) of seed of KS00WGRC44 are available upon written request. Appropriate recognition of source should be given when this germplasm contributes to research

Contribution from the Agricultural Research Station, Virginia State Univ., P. O. Box 9061, Petersburg, VA 23806. Registration by CSSA. Accepted 31 July 2003. \*Corresponding author (tmebraht@vsu.edu).

Published in *Crop Sci.* 44:701–702 (2004).

### Registration of KS00WGRC44 Leaf Rust-Resistant Hard Red Winter Wheat Germplasm

KS00WGRC44 (Reg. no. GP-744, PI 632343) is a hard red winter wheat (*Triticum aestivum* L.) with resistance to leaf



or development of a new breeding line or cultivar. Seed stocks are maintained by the Wheat Genetics Resource Center, Dep. of Plant Pathology, Throckmorton Plant Sciences Center, Kansas State University, Manhattan, KS 66506-5502.

G.L. BROWN-GUEDIRA,\* A.K. FRITZ, B.S. GILL,  
S. SINGH, AND T.S. COX

### References

- Gill, B.S., and W.J. Raupp. 1987. Direct genetic transfers from *Aegilops squarrosa* L. to hexaploid wheat. *Crop Sci.* 27:445–450.  
Huang, L., S.A. Brooks, W. Li, J.P. Fellers, H.N. Trick, and B.S. Gill. 2003. Map-based cloning of leaf rust resistance gene *Lr21* from the large and polyploid genome of bread wheat. *Genetics* 164:655–664.  
Long, D.L., and J.A. Kolmer. 1989. A North American system of nomenclature for *Puccinia recondita* f. sp. *tritici*. *Phytopathology* 79:525–529.

- Porter, K.B., W.D. Worrall, J.H. Gardenhire, E.C. Gilmore, M.E. McDaniel, and N.A. Tuleen. 1987. Registration of TAM 107 wheat. *Crop Sci.* 27:818.  
Roelfs, A.P., R.P. Singh, and E.E. Saari. 1992. Rust diseases of wheat: Concepts and methods of disease management. International Maize and Wheat Improvement Center (CIMMYT), Mexico.

G.L. Brown-Guedira, USDA-ARS and Dep. of Agronomy, Kansas State Univ., Manhattan, KS 66506-5501; A.K. Fritz, Dep. of Agronomy, Kansas State Univ., Manhattan, KS 66506-5501; B.S. Gill and S. Singh, Dep. of Plant Pathology, Kansas State University, Manhattan, KS 66506-5501 and T.S. Cox, Land Institute, Salina, KS. Joint investigation by the USDA-ARS and the Kansas Agricultural Experiment Station. Contribution number 03-123-J. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (gbg@ksu.edu).

Published in *Crop Sci.* 44:702–703 (2004).

## REGISTRATION OF PARENTAL LINES

### Registration of B116 Inbred Line of Maize

Inbred B116 (Reg. no. PL-311, PI 632746) is a yellow maize (*Zea mays* L.) line developed cooperatively by the Iowa Agriculture and Home Economics Experiment Station and USDA-ARS. The line was released 1 March 2003 for its potential value as either a parent for hybrids or as source germplasm in pedigree selection programs.

B116 was derived from an  $F_2$  population developed by selfing the cross of B97 (Hallauer et al., 1994) and B99 (Hallauer et al., 1995). Pedigree selection methods were used in the development of B116; the pedigree of B116 is (B97  $\times$  B99)-047-1-1-1-1-1. Parents of B116 are included in the non-Iowa Stiff Stalk Synthetic (BSSS) heterotic group, usually designated as the Lancaster Sure Crop heterotic group or non-BSSS group.  $S_1$  progenies derived from the (B97  $\times$  B99)  $F_2$  population were screened in the breeding and pest screening nurseries for plant type, seed set and ear size, time of flowering, synchrony of silk emergence and pollen shed, root and stalk strength, and relative resistance to 1st and 2nd generations of European corn borer (*Ostrinia nubilalis* Hübner), northern corn leaf blight (caused by *Exserohilum turcicum* Pass.), gray leaf spot (caused by *Cercospora zae-maydis* Tehon & E.Y. Daniels), and common corn rust (caused by *Puccinia sorghi* Schw.). Greater root strength was emphasized among  $S_1$  progenies because of the poorer root strength of B97. At the  $S_2$  generation, progenies were included in the topcross nursery; tester was a B73 related line. Inbreeding and selection among  $S_2$  progenies were continued in the breeding and pest nurseries. On the basis of 2-yr testcross trials, selected progenies were advanced by inbreeding and crossed to BSSS related lines. Single-cross trials were conducted at 10 to 11 locations for 2 yr within Iowa and also included in the North Central Regional (NCR-167) trials conducted in Nebraska, Iowa (three locations), Illinois, Ohio, Missouri, Pennsylvania, Delaware, and Texas (NCR-167 Annual Report, 2002). In all instances, crosses that included B116 as one parent exhibited consistently high yield levels either comparable to or better than the hybrid checks. Stand levels, stalk strength, plant and ear heights, and

days to flower were similar to the check hybrids. At some location-year trials, B116 had greater moisture levels at harvest and greater incidence of root lodging, but in other instances they were similar to the hybrid checks.

B116 is a tall, vigorous line that has good tolerance to 1st and 2nd generations European corn borer, gray leaf spot, and northern corn leaf blight. Plant and ear heights of B116 are similar to B110 but greater than for B73 and Mo17. Flowering dates of B116 are similar to Mo17 but 3 d later than for B73. Hybrids that include B116 had moisture levels at harvest 1 to 2% greater than the adapted check hybrids. B116 would be classified in the AES700-800 maturity group. B116 has long ears with 12-kernel rows of large semident kernels on pink cobs. Good quality grain is obtained with good seed set either by hand- or open-pollination. In some instances, *Fusarium moniliforme* J. Sheld. var. *subglutinans* Wollenweb. & Reinking has been observed on the tips of the ear. B116, as a line, has a clean plant type and has exhibited good stalk and root strength in the breeding nurseries.

Seed of B116 is maintained by the Iowa Agriculture and Home Economics Experiment Station, and is distributed upon request by the Committee for Agriculture Development, 133 Curtiss Hall, Iowa State University, Ames, IA 50011-1050.

A.R. HALLAUER,\* K.R. LAMKEY, AND P.R. WHITE

### References

- Hallauer, A.R., K.R. Lamkey, W.A. Russell, and P.R. White. 1994. Registration of B97 and B98, two parental inbred lines of maize. *Crop Sci.* 34:318–319.  
Hallauer, A.R., K.R. Lamkey, W.A. Russell, and P.R. White. 1995. Registration of B99 and B100 inbred lines of maize. *Crop Sci.* 35:1714–1715.

Dep. of Agronomy, Iowa State University, Ames, IA 50011-1010. This journal paper of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa, Project 3742, was supported by Hatch Act and State of Iowa funds. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (hallauer@iastate.edu).

Published in *Crop Sci.* 44:703 (2004).

# REGISTRATION OF MAPPING POPULATIONS

## Registration of NC113 Soybean Mapping Population

NC113 Soybean Mapping Population [*Glycine max* (L.) Merr.] (Reg. no. MP-1, NSL 426154) was developed by the USDA-ARS and the North Carolina Agricultural Research Service (NCARS). The genetic marker data for NC113 were collected at the Georgia Agricultural Experiment Stations. This population and its genetic marker data have been used extensively to map genes and quantitative trait loci (QTL) (Table 1; Boerma and Mian, 1999). It was released to the public in July 2001 by the USDA-ARS and NCARS to facilitate the mapping of additional genes that may segregate in the population and to serve as an instructional tool for training in genetic mapping and QTL discovery. The 116  $F_4$ -derived lines in this population have been scored for nine phenotypic traits and 232 polymorphic DNA markers. The population and data set are freely available upon request. The provided data set may be used to (i) create genetic linkage maps, ii) map “classical” soybean genes conditioning flower color, pod wall color, and resistance to bacterial pustule [caused by *Xanthomonas campestris* pv. *glycines* (Nakano 1919) Dye 1978b] onto a linkage map, and (iii) identify DNA markers associated with QTL for the traits maturity, plant height, lodging, 100-seed weight, and seed protein, and oil content. Researchers and teachers may also assay the NC113 population members directly for additional phenotypic traits and genetic markers and apply QTL analysis.

## Population Development

Population NC113 was derived from the hybridization of ‘Young’ (PI 508266) and PI 416937 (Seed of the specific parental lines used are stored at NCGRP as PI 633743 and PI 633742, respectively). Young is a Maturity Group VI cultivar that was grown widely in the southern USA before 1990 (Burton et al., 1987). It has a determinate growth type, white flowers, gray pubescence, tan pod walls at maturity, and yellow seed with buff hila. PI 416937 is a Maturity Group VI accession from Japan and is phenotypically distinct from any U.S. cultivar or ancestor. The PI 416937 was selected as a parent of NC113 because it exhibits slow wilting under drought compared to most U.S. soybean cultivars (Sloane et al., 1990). It also possesses larger leaves, a more prolific root system, greater resistance to Mexican bean beetle [*Epilachna varivestis* (Mulsant)] and greater tolerance to AI than most U.S. cultivars (Carter et al., 1999; Kraemer et al., 1988; Bianchi-Hall et al., 1988; Villagarcia et al., 2001). It has a determinate growth type, purple flowers, gray pubescence, brown pod walls at maturity, yellow seed with buff hila, and is highly susceptible to pod dehiscence. PI 416937 is a parent of N7001, a high yielding Maturity Group VII cultivar developed by the USDA-ARS and NCARS (Carter et al., 2003).

The 116  $F_4$ -derived randomly selected inbred lines of NC113 were developed by the single seed descent breeding method (Brim, 1966; Lee et al., 1996a). Thus, all lines traced to a different random  $F_2$  plant, a population structure that facilitated maintenance of genetic variability in the population and DNA marker mapping. The  $F_1$  seed were produced at the Central Crops Research Station at Clayton, NC, in 1990 and the  $F_1$  plants were grown at the USDA-ARS Tropical Agriculture Research Station (TARS), Isabela, PR, the following winter. The  $F_2$  plants were advanced at Clayton, NC, in 1991 and the following winter at TARS. In 1992, individual  $F_4$  plants were harvested at Clayton, NC. Progeny rows were

increased at the Sandhills Research Station near Windblow, NC, in 1993. The population and its parents were characterized for several agronomic and seed traits in 1994 (Table 1) (Lee et al., 1996a, 1996b; Mian et al., 1996b).

## DNA Markers

The 116 lines in NC113 have been characterized with 232 genetic markers: 128 Restriction Fragment Length Polymorphism (RFLP) markers, 101 Simple Sequence Repeat (SSR) markers, and three simply inherited classical genes (*L2*, *W1*, and *Rxp*). The *L2* locus partially controls pod color, *W1* controls flower color, and *Rxp* conditions reaction to bacterial pustule (caused by *Xanthomonas campestris* pv. *glycines*) (Lee et al., 1996a; Mian et al., 1996a; Narvel et al., 2001). The population was characterized initially with RFLP markers and subsequently with SSR markers as they became publicly available (Cregan et al., 1999). Polymorphic RFLP probes were obtained from various sources including soybean and four other leguminous species. The origin of a probe was denoted by the prefix in its name designation. Probes designated “Bng” were from common bean (*Phaseolus vulgaris* L.) and were obtained from J.M. Thome (Cent. Int. Agric. Tropical). Probes designated “CR” were cDNA probes from a peanut (*Arachis hypogaea* L.) root library and those designated “CS” were from a peanut shoot library. The peanut probes were obtained from G.D. Kochert (Univ. of Georgia). Probes designated “GAC” were from alfalfa (*Medicago sativa* L.) and were obtained from J.H. Bouton (Univ. of Georgia) and those designated “M” were from mungbean (*Vigna radiata* L.) and were obtained from N.D. Young (Univ. of Minnesota). All other RFLP probes were from soybean cDNA and/or genomic clones and were obtained from R.C. Shoemaker (USDA/Iowa State Univ.), K.G. Lark (Univ. of Utah), or from R.T. Nagao (Univ. of Georgia). A suffix in the name designation of an RFLP probe denoted its correspondence (or lack thereof) to one employed in the public soybean genetic linkage map (Cregan et al., 1999). If a RFLP marker was identical to a marker present on the consensus map, it was assigned the same number suffix used on the consensus map [see SoyBase at <http://soybase.agron.iastate.edu/> (verified 17 October 2003); go to SoyBase, Map\_Collection,!Composite\_Genetic\_Map, Map]. The RFLP markers that were unique to the NC113 population were given a letter suffix. Those RFLP markers that showed dominance were given a “n” designation as the terminal component of the marker name. Twenty-one of the 128 RFLP markers were dominant and the rest exhibited codominance. The SSR markers were all developed from soybean and identified by the prefix “Sat\_,” “Satt,” or “Sct\_” (Cregan et al., 1999). The SSR data were collected using the procedures similar to those reported by Mian et al. (1999). All 101 SSR markers mapped in the NC113 population exhibited codominant inheritance. Although flower color is a dominant trait, the *W1* locus could be treated as a codominant marker for mapping purposes because segregation for flower color within  $F_4$ -derived lines, if present, could be detected. The *L2* and *Rxp* loci were mapped as dominant markers because segregation within  $F_4$ -derived lines for pod wall color and disease resistance were difficult to assay.

## Linkage Map

An initial linkage map of this population was generated using RFLP markers and the *W1* locus and a  $F_2$  population

**Table 1.** Means and ranges of Young, PI 416937, and their 116  $F_4$ -derived progeny for agronomic (Lee et al., 1996a) and seed traits (Lee et al., 1996b; Mian et al., 1996b) and the number of putative independent QTL detected for each trait. Scores for individual members of the population are freely available upon request.

	Agronomic traits†			Seed traits†		
	Maturity‡	Lodging§	Plant height¶	Weight	Protein††	Oil††
	d	Score	cm	mg seed <sup>-1</sup>	g kg <sup>-1</sup>	
Young	50	2.8	109	160	441	202
PI 416937	47	3.3	64	174	452	184
Progeny mean	54	3.1	89	173	447	192
Progeny range	34–69	2.1–4.4	71–127	134–227	431–469	182–201
No. of QTL	5	8	11	7	7	4

† Data were collected from multiple-row plots grown at three or four locations for a total of seven or nine replications in 1994 in North Carolina and Georgia.

‡ Maturity was recorded as the number of days after 31 August when 95% of pods within a plot had reached mature color.

§ Lodging was recorded on a scale of 1 (all plants erect) to 5 (all plants prostrate) at maturity.

¶ Plant height at maturity was recorded as the average distance from the soil surface to the terminal node of the main stem.

†† Seed protein and oil concentrations were expressed on a moisture-free basis.

structure in Mapmaker-Exp 3.0 to identify 31 linkage groups covering approximately 1600 cM (Lee et al., 1996a). In a later study, the map was reconstructed according to its  $F_4$  population structure with GMendel 3.0 to reveal 33 linkage groups representing approximately 973 cM (Mian et al., 1996a). The linkage map developed for the current release includes the addition of the 101 SSR markers, the *L2* locus, and the *Rxp* locus to the genetic markers employed previously. The current linkage map was constructed in GMendel 3.0 using the Kosambi map

**Table 2.** Description of 30 linkage groups mapped in the NC113 soybean DNA mapping population. The map distance and marker distribution for the linkage groups were generated from analysis of the 116  $F_4$ -derived progeny from NC113.

Linkage group‡	Map distance§	No. of markers		
		Total	RFLP	SSR
	cM			
YP1 (A1)	60.9	7	4	3
YP2 (A2)	170.2	15	7	8
YP3 (A2)	4.7	3	3	0
YP4 (B1)	108.8	10	8	2
YP5 (B2)	22.3	3	1	2
YP6 (B2)	6.1	2	0	2
YP7 (C1)	8.4	4	2	2
YP8 (C1)	95.2	7	4	3
YP9 (C2/N)	233.9	22†	10	11
YP10 (C2)	17.1	3	2	1
YP11 (D1a)	128.3	11	6	5
YP12 (D1b)	36.4	3	1	2
YP13 (D1b)	17.6	2	2	0
YP14 (D2)	110.5	12†	3	8
YP15 (D2)	22.0	2	0	2
YP16 (E)	29.9	6	5	1
YP17 (F)	140.2	16†	9	6
YP18 (F)	14.9	2	1	1
YP19 (G)	78.1	13	7	6
YP20 (G)	0.4	2	2	0
YP21 (H/M)	122.6	10	5	5
YP22 (H)	63.5	5	4	1
YP23 (I)	46.4	5	3	2
YP24 (I)	43.0	4	2	2
YP25 (J)	72.9	15	7	8
YP26 (E/K)	241.8	22	15	7
YP27 (K)	8.3	2	1	1
YP28 (A1/L)	121.8	13	7	6
YP29 (L)	21.4	3	2	1
YP30 (N)	47.9	8	5	3
Total	2095.5	232†	128	101

† The total number of markers includes *L2* for partial control of pod color on YP9, *Rxp* for bacterial pustule resistance on YP14, and *WI* for flower color on YP17.

‡ YP linkage groups refer to linkage groups developed through analysis of NC113 Soybean DNA mapping population. Letter designations in parenthesis refer to linkage groups of the public soybean genetic map (Cregan et al., 1999).

§ Map distance refers to the sum of recombination frequencies between all adjacent markers on a linkage group.

function, a minimum LOD of 3.0, and a maximum recombination frequency (rmax) of 0.38 (approximately equal to 50 cM) (Holloway and Knapp, 1993). This more robust genetic linkage map consists of 232 markers mapped to 30 linkage groups covering approximately 2100 cM (Table 2).

The 30 linkage groups of NC113 were given a number designation and the common prefix “YP,” which was a reference to the parents, Young and PI 416937 (Table 2). The 30 YP-linkage groups were compared to the 20 linkage groups of the public soybean genetic linkage map by RFLP and SSR markers that were common to both (e.g., all SSR and approximately one-half of the RFLP markers). Agreement between the two maps was good, with the 30 YP-linkage groups corresponding to segments of 19 of the 20 linkage groups of the public soybean genetic linkage map (Cregan et al., 1999). A single linkage group of the public soybean genetic linkage map often corresponded to multiple YP linkage groups, because fewer markers were employed in the development of the NC113 linkage map (232 vs. 523 to 1004 depending on the population for the public soybean genetic linkage map; Cregan et al., 1999). In some instances, the less complete resolution of linkage groups for the NC113 population resulted in a correspondence between a single YP linkage group and two—rather than one—-independent linkage groups of the public soybean genetic linkage map (consensus map). This “pseudo linkage” effect was exemplified by linkage group YP9 in which Satt584 from linkage group N on the consensus map was linked 49.3 cM from Satt371, which is located on linkage group C2 of the consensus map. Although the user needs to be aware of this pseudolinkage effect, it does not present an obstacle to data analysis and interpretation.

### QTL Analysis

The phenotypic diversity among lines within population NC113 has allowed the identification of a number of putative QTL for pod maturity, lodging resistance, plant height, seed weight, and seed protein and oil content (Table 1). Additional QTL have been identified in the YP population that condition water use efficiency, leaf ash, specific leaf weight, leaf size, pod dehiscence, and aluminum tolerance (Table 3).

**Table 3.** Number of putative independent QTL for six additional traits that have been evaluated in the Young  $\times$  PI 416937 soybean mapping population.

Trait	No. of QTL	Reference
Water use efficiency	4	Mian et al. (1996a)
Leaf ash	6	Mian et al. (1996a)
Specific leaf weight	6	Mian et al. (1998)
Leaf size	3	Mian et al. (1998)
Pod dehiscence	5	Bailey et al. (1997)
Aluminum tolerance	5	Bianchi-Hall et al. (2000)



The allelic array for the 232 genetic markers (Table 2), the phenotypic data (Table 1) for selected agronomic traits, and the linkage map are available for the 116 lines in electronic spreadsheet form upon request to H.R. Boerma. These data and the pair-wise genetic linkage distances for markers within each linkage group are available as a link from the SoyBase Homepage (<http://129.186.26.94/>; verified 13 Jan. 2004). Specific questions related to DNA marker and phenotypic data collection should be directed to H.R. Boerma.

Small seed samples of Young, PI 416937, and the 116  $F_4$ -derived lines in NC113, designated from N93-S-1 to N93-S-179 (nonconsecutive numbers), are available from T.E. Carter, Jr. for at least 5 yr.

J.M. NARVEL, T.E. CARTER, JR.,\* L.R. JAKKULA,  
J. ALVERNANZ, M.A. BAILEY, M.A.R. MIAN,  
S.H. LEE, G.J. LEE, AND H.R. BOERMA

### References

- Bailey, M.A., M.A.R. Mian, T.E. Carter, Jr., D.A. Ashley, and H.R. Boerma. 1997. Pod dehiscence of soybean: Identification of quantitative trait loci. *J. Hered.* 88(2):152–154.
- Boerma, H.R., and M.A.R. Mian. 1999. Soybean quantitative trait loci and marker assisted breeding. p. 68–73. *In* H. E. Kauffman (ed.) Proceedings of the World Soybean Research Conference, VI, Chicago. 4–7 Aug. 1999. National Soybean Research Lab., Urbana IL.
- Bianchi-Hall, C., T.E. Carter, Jr., T. Ruffy, C. Arellano, H.R. Boerma, D.A. Ashley, and J.W. Burton. 1998. Heritability of aluminum tolerance derived from soybean PI 416937. *Crop Sci.* 38:513–522.
- Bianchi-Hall, C.M., T.E. Carter, Jr., M.A.R. Mian, T.W. Ruffy, D.A. Ashley, H.R. Boerma, C. Arellano, R.S. Hussey, and W.A. Parrott. 2000. Aluminum tolerance associated with quantitative trait loci derived from soybean PI 416937 in hydroponics. *Crop Sci.* 40:538–545.
- Brim, C.A. 1966. A modified pedigree method of selection in soybean. *Crop Sci.* 6:220–225.
- Burton, J.W., C.A. Brim, and M.F. Young. 1987. Registration of Young soybean. *Crop Sci.* 27:1093.
- Carter, T.E., Jr., J.W. Burton, D.T. Bowman, Z. Cui, X. Zhou, M.R. Villagarcia, A.S. Niewoehner, and M.O. Fountain. 2003. Registration of 'N7001' soybean. *Crop Sci.* 43:1127–1128.
- Carter, T.E., Jr., P.I. DeSouza, and L.C. Purcell. 1999. Recent advances in breeding for drought and aluminum resistance in soybean. p. 106–125. *In* H. E. Kauffman (ed.) Proceedings of the World Soybean Research Conference, VI, Chicago. 4–7 Aug. 1999. National Soybean Research Lab., Urbana IL.
- Cregan, P.B., T. Jarvik, A.L. Bush, R.C. Shoemaker, K.G. Lark, A.L. Kahler, N. Kaya, T.T. Van Toai, D.G. Lohnes, J. Chung, and J.E. Specht. 1999. An integrated genetic linkage map of the soybean genome. *Crop Sci.* 39:1464–1490.
- Holloway, J.L., and S.J. Knapp. 1993. Gmendel 3.0 users guide. Department of Crop and Soil Sciences, Oregon State University.
- Kraemer, M.E., M. Rangappa, P.S. Benepal, and T. Mebrahtu. 1988. Field evaluation of soybeans for Mexican bean beetle resistance. I. Maturity Groups VI, VII, and VIII. *Crop Sci.* 28:497–499.
- Lee, S.H., M.A. Bailey, M.A.R. Mian, T.E. Carter, Jr., D.A. Ashley, R.S. Hussey, W.A. Parrott, and H.R. Boerma. 1996a. Molecular markers associated with soybean plant height, lodging, and maturity across locations. *Crop Sci.* 36:728–735.
- Lee, S.H., M.A. Bailey, M.A.R. Mian, T.E. Carter, Jr., E.R. Shipe, D.A. Ashley, W.A. Parrott, P.S. Hussey, and H.R. Boerma. 1996b. RFLP loci associated with soybean seed protein and oil content across populations and locations. *Theor. Appl. Genet.* 93:649–657.
- Mian, M.A.R., M.A. Bailey, D.A. Ashley, R. Wells, T.E. Carter, Jr., W.A. Parrott, and H.R. Boerma. 1996a. Molecular markers associated with water use efficiency and leaf ash in soybean. *Crop Sci.* 36:1252–1257.
- Mian, M.A.R., M.A. Bailey, J.P. Tamulonis, E.R. Shipe, T.E. Carter, Jr., W.A. Parrott, D.A. Ashley, R.S. Hussey, and H.R. Boerma. 1996b. Molecular markers associated with seed weight in two soybean populations. *Theor. Appl. Genet.* 93:1011–1016.
- Mian, M.A.R., R. Wells, T.E. Carter, Jr., D.A. Ashley, and H.R. Boerma. 1998. RFLP tagging of QTLs conditioning specific leaf weight and leaf size in soybean. *Theor. Appl. Genet.* 96:354–360.
- Mian, M.A.R., T.W. Wang, D.V. Phillips, J.A. Alvernaz, and H.R. Boerma. 1999. Molecular mapping of the *Rcs3* gene for resistance to frogeye leaf spot in soybean. *Crop Sci.* 39:1687–1691.
- Narvel, J.M., L.R. Jakkula, D.V. Phillips, T. Wang, S.H. Lee, and H.R. Boerma. 2001. Molecular mapping of *Rxp* conditioning reaction to bacterial pustule in soybean. *J. Hered.* 92:267–270.
- Sloane, R.J., R.P. Patterson, and T.E. Carter, Jr. 1990. Field drought tolerance of a soybean plant introduction. *Crop Sci.* 30:118–123.
- Villagarcia, M.R., T.E. Carter, Jr., T.W. Ruffy, A.S. Niewoehner, M.W. Jennette, and C. Arellano. 2001. Genotypic rankings for aluminum tolerance of soybean roots grown in hydroponics and sand culture. *Crop Sci.* 41:1499–1507.

H.R. Boerma, J.M. Narvel, L.R. Jakkula, J. Alvernaz, and G.J. Lee, Dep. of Crop and Soil Sciences, 3111 Miller Plant Sciences Bldg, Univ. of Georgia, Athens, GA 30602-7272; T.E. Carter Jr., USDA-ARS, North Carolina State Univ., 3217 Ligon St., Raleigh, NC 27695-7631; M.A. Bailey, Pioneer Hi-Bred International, Inc. 7300 NW 62nd Avenue, P.O. Box 1004, Johnston, IA 50131-1004; M.A.R. Mian, Noble Foundation, 2510 Sam Noble Parkway, Ardmore, OK 73402; S.H. Lee, School of Plant Science, Seoul National University, Suwon 441-744, Korea. Registration by CSSA. Accepted 31 Aug. 2003. \*Corresponding author (tommy\_carter@ncsu.edu).

Published in *Crop Sci.* 44:704–706 (2004).